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THE JOURNAL OF ENGINEERING EDUCATION

Published by THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

NEW SERIES VOL. XXIX., NO. 1 | SEPTEMBER, 1938 | Subscription Price $3.00 per year Single copies 50 cents

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440 Fourth Avenue — **New York, N. Y.**

Engineering Dept. Not to go pub.

THE JOURNAL OF ENGINEERING EDUCATION

Published by the Society for the Promotion of Engineering Education

Published under the Supervision of the Publication Committee.
K. T. Compton, S. B. Earle, F. L. Bishop, Editor, University of Pittsburgh.
Published at Prince and Lemon Sts., Lancaster, Pa.

Entered as second-class matter at the Post Office at Lancaster, Pa., under the Act of March 3, 1870.

New Series, Vol. XXIX, No. 1 | SEPTEMBER, 1938 | Subscription Price, $3.00 per year. Single Copies, 50 cents

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ROBERT LEMUEL SACKETT

THE LAMME MEDAL

THE LAMME MEDAL for Achievement in Engineering Education was awarded to ROBERT LEMUEL SACKETT for his work in coördinating the thought of industry and education for the improvement of their understanding of their mutual problem in the selecting and developing potential leaders; for his intensive work within this field within the State of Pennsylvania and neighboring states; for his conception of Industrial Engineering as a curriculum; for his influence in the development of the scope of engineering extension as a department of higher education; for his effective appreciation of the necessity of essential symmetry in the early intellectual, physical and spiritual growth of genuine leaders;

and for his own high exemplification to his students of these essentials of character.

Dean Sackett, the eleventh Lamme Medalist of the Society for the Promotion of Engineering Education, was born December 2, 1867, at Mount Clemens, Michigan. He received his education at the University of Michigan, and has from his Alma Mater the degrees, B.S. in C.E., 1891; C.E., 1896; Eng.D. (honorary) 1937.

His first educational work was in the latter part of 1891 when he began his career as a teacher, and since then has always combined teaching with engineering practice. From the fall of 1891 to 1907 he was Professor of Applied Mathematics at Earlham College, and from 1896 to 1907, head of the mathematical and astronomy department there. From 1907 to 1915 he was Professor of Sanitary, Hydraulic and Municipal Engineering at Purdue University. From 1915 to 1937 he was Dean of the School of Engineering at The Pennsylvania State College, retiring from educational work in that year. During the past year he has devoted himself largely to the work of the Engineers' Council for Professional Development.

Dean Sackett's practical engineering work began even before his educational career. Upon graduation in 1891 he became a recorder with the U. S. River and Harbor Survey. While at Purdue, 1910 to 1915, he was engaged as a Special Engineer, Indiana State Board of Health, concurrently serving as Consulting Engineer for various State Commissions and municipalities and institutions. He has served the Erie Railroad as a Consultant. During the World War he was a member of the War Department Committee on Education in charge of the Special Vocation Training at Pennsylvania State College, and in charge of the Student Army Training Corps there.

Dean Sackett is a member of Phi Gamma Delta, Triangle, Tau Beta Pi, Phi Kappa Phi, Sigma Xi; the A. A. A. S., A. S. C. E., S. P. E. E., A. S. M. E. He was President of the S. P. E. E., 1927–8, and Vice President A. S. M. E., 1936–7.

He is the author of numerous papers which have appeared in education and engineering publications, and of the volume "The Engineer, His Work and His Education."

KARL TAYLOR COMPTON

President, Society for the Promotion of Engineering Education, 1938–39

Karl Taylor Compton holds an eminent place in American education, having distinguished himself as a physicist, a teacher, an administrator, and a humanitarian. To the Massachusetts Institute of Technology, of which he became the eleventh president in 1930, Dr. Compton brought a new conception of the values of science and engineering in their application toward the advancement of civilization. There he has demonstrated himself to be a leader of vision and extraordinary energy.

Believing that the aim of all education is a culture based on a sympathetic understanding and appreciation of life, Dr. Compton has sought to combine the precise knowledge of the professions with studies of broad human significance. The responsibility of institutions of higher learning, he has said, is to impart to the minds of the leaders of tomorrow a rigorous intellectual honesty, a reverence for truth, an open-minded approach to new situations and a balanced judgment.

He is strong in his conviction that education in science and engineering, combined with fundamental studies in the social implications of the professions, is the best preparation for the advancement of civilization. His belief that municipal, state and national governments provide technically trained men with broad opportunities for raising the standards of public service is evidenced by his own generous contribution of time to public activities. These have involved the Chairmanship of the Science Advisory Board, appointed by President Roosevelt to assist the Government in the solution of national problems, and membership on numerous other agencies, including the Business Advisory and Planning Council of the Department of Commerce, on which he served as member of the executive committee, the Visiting Committees of the Bureau of Standards and the United States Weather Bureau, the Massachusetts Commission for the Stabilization of Employment, the Governor's Committee on Public Utility Rates in Massachusetts, the Research Advisory Board of the Association of American Railroads, and the Committee of Inquiry of the Department of Communication and Transit of the League of Nations. During the War he was Associate Scientific Attaché at the American Embassy in Paris.

KARL T. COMPTON

Throughout the trying years of economic instability, Dr. Compton has constantly directed attention to the many avenues in which science offers definite promise of improving standards of living and health. Tangible evidence of this has been given by the work, under his guidance, of his own institution, not alone through education, but by research in fields of specific public benefit, and by his interest in the far-reaching program of the National Farm Chemurgic Council. The research of the future, Dr. Compton believes, must concern not only new discoveries, but the development of new industries based upon the work of scientists and engineers. In this field he sees prospects for new products, and hope for increased employment.

Born at Wooster, Ohio, 51 years ago, Dr. Compton is the eldest of the three distinguished sons of Elias and Otelia Augspurger Compton. His late father was a Presbyterian clergyman, emeritus dean and professor of philosophy of the College of Wooster. One of his brothers is Dr. Arthur H. Compton, professor of physics at the University of Chicago, and Nobel Laureate in Physics in 1927; the other, Dr. Wilson M. Compton is secretary and manager of the National Lumber Manufacturers' Association. His only sister is the wife of the President of Ewing College, Allahabad, India.

Dr. Compton was graduated from the College of Wooster in 1908 with the degree of bachelor of philosophy. A year later he received the degree of master of science. Princeton University, where he later became head of the department of physics, granted him his doctorate in 1912, and in the years since he has been awarded many honorary degrees. In 1923 his alma mater bestowed on him the honorary degree of doctor of science, as did Lehigh University in 1927, Princeton University in 1930, Stevens Institute of Technology in 1931, and Boston University and Clarkson College of Technology in 1932. He received an honorary doctorate of engineering from Brooklyn Polytechnic Institute in 1930 and from the Case School of Applied Science in 1931. The honorary degree of doctor of laws he received from Harvard University in 1930, from the University of Wisconsin in 1934, from Middlebury College and Williams College in 1936, and from Johns Hopkins University and Franklin and Marshall College in 1937.

The Rumford Medal of the American Academy of Arts and Sciences, one of the most distinguished scientific honors in the world, was awarded to Dr. Compton in 1931, in recognition of his contributions to the field of thermionics, the study of electron emission from hot filaments and cathodes, and of spectroscopics, the investigation of matter by means of light waves.

Dr. Compton is a fellow and councillor of the American Physi-

cal Society; a fellow of the American Optical Society, the Institute of Aero. Sciences; and a member of the National Academy of Sciences, American Philosophical Society, American Academy of Arts and Sciences, American Association for the Advancement of Science, Franklin Institute, American Institute of New York, Deutschen Physik. Gesell., American Institute of Electrical Engineers, American Society of Mechanical Engineers, S. P. E. E., and Phi Beta Kappa, Tau Beta Pi, Sigma Xi, and Alpha Tau Omega.

Since 1932 Dr. Compton has been in intimate contact with engineering education as chairman of the E. C. P. D. Committee on Engineering Schools, in which capacity he has given with characteristic unselfishness of his energy and ability.

ENGINEERING EDUCATION AND SOCIAL PROGRESS

By KARL T. COMPTON

President of the Society

As a representative organization in the field of engineering education S. P. E. E. can do much toward shaping the design of engineering in accordance with the best interests of society. In this present stage of national adjustment it seems logical, therefore, that we should turn our thoughts to an appraisal of the rôle of engineering in our society, since to do so should better enable us to chart a wise course along which engineers and engineering can best perform that service to the public which is the justification for their existence.

A consideration of these matters may be based on just two questions: "What elements are involved in our American program for social progress?" and "What is the proper rôle of engineering in each element?"

A study of our program will reveal the following important facts: America needs work for some millions of unemployed. She craves protection against the perils of nature, such as floods, earthquakes and droughts, and against the man-made perils of transportation, fire and group violence. Wisdom urges her to seek conservation of her natural resources of soil, minerals and power. She needs better housing for large groups of her population. She realizes the advantages which would derive from a more efficient system of distribution of her products to her consuming public. Her people are striving, sometimes with violence, for higher wages, shorter hours of labor and a generally higher standard of living.

These are the things which our federal administration and local governments have established as major goals, and which certainly are the most vocalized aspirations of our people. And significantly, every one of these objectives not only involves engineering, but can only be achieved through engineering, by engineers! This is a striking fact, of large significance in determining what should be our attitude toward the engineer and his training.

In determining the rôle of engineering in this far-reaching program, each feature may be considered individually. The first of those above listed is reduction of unemployment.

Far and away the greatest task which has faced the American people in the last five years has been to take care of the great group

of unemployed which appeared with the depression. While a program of providing emergency work and outright relief when necessary seems justifiable, the basic problem, as evidenced by the present unemployment figure remains far from being solved.

There have been several schools of thought as to the nature of a permanent solution falling between the share-the-work movement reduced to an absurd extreme, and the claim of those who foresee the solution in the creation of new industries by engineering science. Certainly we have a responsibility to share the available work to as great an extent as this may be consistent with good production and general economy. On the other hand, the positive, constructive cure for unemployment is to provide more really useful employment, which means to provide more things which people want and are willing to pay and to work for. In this constructive solution to the unemployment problem the engineer obviously holds a key position, in so far as jobs for the future must be sought through science and invention which join in productive engineering.

A second major feature of our program is protection against both natural and man-made perils. Here the job is primarily one for the engineer, whether it be flood control, prevention of drought through water storage and measures for impounding water in the soil, or highway safety through improved highway and automobile design. Safety in the air, while still carrying a large element of the human equation, is nevertheless ultimately a problem for the engineer to design and construct planes of such stability, durability and dependability as to make safety largely automatic in the hands of the pilot. The national defense, fire and earthquake protection, control of disease through drainage and waste disposal all involve engineering of the highest calibre.

The conservation and use of our national resources for the best ultimate public interest is a third great feature of our program for social progress. Important aspects of this include the effective use of soil, water, minerals, timber, waterways, and even manpower. Several major projects are in various stages of completion including the Passamaquoddy Tidal Project, the Tennessee Valley Authority, the Grand Coulee and Bonneville Dams, the Soil Erosion Service, and the Oil Production Control. Nearly every aspect of this program, as evidenced in the list above, is essentially an engineering job.

From the work which will be done on these and other similar projects there will undoubtedly emerge much constructive improvement of the physical plant of the country. The great question to be answered, however, is whether the economic and social results of this great program have justified the expense; or in other words,

has the program been efficiently conceived and carried through? When these questions are examined the criterion will be the analysis of the engineer, and the answer will probably contain the conclusion that it will always be very much to the best interest of the country to have the decisions as to such programs made with more attention to the judgment of the engineer than has been true in the past.

Another important aspect of the rôle of the engineer in the conservation of our national resources is the provision for the country's needs after certain of its resources shall have been exhausted.

There seems to be general agreement that a notable improvement in the social conditions of the country will come through a great housing program. In the last analysis, however, the question of building houses and not building houses is an economic one and depends on the answer to the question: "Can the houses be built of such a type and for such a price that they can be sold or rented at a reasonable profit?" The answer to this question is definitely in the hands of the engineer, for it is the success of his work which determines the materials for construction, the methods for erection, and the ultimate value of the finished product. Before any great housing program can be successful much must first be done by the engineer in developing inexpensive but suitable materials and methods.

Another element in the program for social progress is the search for more efficient methods of distribution of the products of agriculture and industry. There are many ways that the engineer can contribute to this problem, such as increasing the efficiency of the methods of transportation, improving methods of packaging and preserving, and developing methods for easy storage and quick handling of goods.

A final major feature of our program, and predominantly now in the minds of the American public, is the effort to secure higher wages, shorter hours of labor, and a generally higher standard of living. Logically there are two approaches to the desired objective in these matters, one through distribution and the other through creation. The former is a matter of legislation and negotiation, while the latter is primarily the responsibility of the engineer.

It is undoubtedly good and proper social philosophy and for the ultimate best interests of the human race that profit and wealth be distributed more evenly than has been the general tendency of the past. A close analysis of the situation, however, discloses the fact that there are definite limits and decided dangers in carrying this policy too far. The limits are disclosed by a survey of the amount of wealth or the amount of profit which is available for

distribution, and are found to be disappointingly low. The principal danger in carrying this tendency too far is the certainty that to do so will dry up those sources of financial support which have proved to be the most potent means of creating new industry, providing new jobs and new profit. Consider therefore the alternative of creating higher wages through the creation of new wealth by engineering methods.

Engineering methods in industry tend to raise wages by creation of new wealth in two ways, one through the development of new industries which directly provide new products, new employment and new profits, and less directly through the development of labor-saving and quantity production devices. These latter methods result also in shorter hours of labor, and the natural combined effect of the two methods of creating wealth is a material raising in the standards of living. In these days of agitation for higher wages and shorter hours and a higher standard of living, it is important to remember the fundamental fact that it is only efficiency of production through engineering methods which makes general improvement in these lines possible.

Having thus considered the rôle of the engineer with reference to some of the best recognized elements in the American program for social progress, let us turn briefly to the consideration of another problem which is fundamentally related to these and to all activities in our national life, namely the problem of leadership.

It is a rather discouraging and frequently startling situation in which we so often have to admit that proper leadership is lacking and is apparently unavailable. One could very well take the stand, therefore, that in all the elements of our program there is fundamentally involved the problem of developing leaders. What contribution does the field of engineering make to the solution of this human problem?

An answer to this question is suggested in statistics gathered a few years ago by Robert H. Spahr, Director of Curriculum and Instruction Development of the General Motors Institute of Technology, in connection with a report to S. P. E. E. This survey of the officers of companies in American industry revealed the startling fact that graduates of engineering and technical schools are many times more likely to be found in positions of authority than are graduates of other types of colleges, or non-college men.

By way of summary, therefore, of this survey of the place of engineers and engineering in the American program for social progress, we may arrive at two simple and direct statements of fact. One is that the engineer, through the very nature of his experience and field of interest, has a most important position in bringing to accomplishment the various elements of this great program.

A second is that experience has demonstrated the engineering type of training to be an unusually effective training for responsible positions in American industry.

With these statements in mind, the conclusions as to our policy in regard to the rôle of engineers in this program for social progress are clear. It is of great importance to our social welfare that engineers be given a more important rôle in the determination of national policies directed toward this program. They should be given the encouragement and stimulation which will lead to their best performance in the achievement of many of these objectives. Their environment, whether in government, industry or educational institution, should be made conducive to productive effort. Finally those of us who have a responsibility for engineering education in this country should take fresh courage from realization of the fundamental importance of our task and conviction that such contributions as we and our institutions can make will be of such public value as to justify our best efforts.

THE CULTURAL AND PROFESSIONAL PHASES OF ENGINEERING EDUCATION *

By S. B. EARLE, President, Society for the Promotion of Engineering Education; Dean of Engineering, Director, Experiment Station, Clemson Agricultural College

During the last few years there has been a good deal of discussion about the broadening of engineering education by giving more time to the humanities at the expense of part of the time devoted to some of the technical subjects. While considerable study has been made and much written from time to time it seems worthwhile to devote one meeting of the Society to the subject and thus bring together at this time the best thought of some of our engineering educators and practising engineers, and at the same time by general discussion, create an interest in the subject which will tend to aid the engineering teachers in stimulating an interest on the part of engineering students. It shall not be my purpose to try to cover the subject but rather to open it up, knowing that there are others to follow me well qualified to discuss the subject in greater detail.

The committee that conducted the five year study of engineering education a few years ago made a number of recommendations along this line. Many of the suggestions were incorporated in curricula revisions following the study. It would be of interest to know how general these changes were and how many institutions participated. It would also be of interest to know how effective such changes have been in accomplishing the objects sought.

Since there continues to appear suggestions from employers and others stressing the need of further broadening, it seems that either the changes in curricula were not very general, or, if the changes were made, the courses have not been as effective as they should have been. Since the depression has changed conditions to so great an extent it seems wise to give further thought to the subject with the hope that we may reach a wise solution of this along with the many other problems that have arisen.

While engineering is very old, the profession of engineering is not so old. What engineering there was in the early days was done by men who had some mechanical turn and became proficient in doing work of a simple engineering nature either by experience or

* Presidential Address presented at the 46th Annual Meeting, S. P. E. E., College Station, Texas, June 27–30, 1938.

often by working as an apprentice to some one who had developed some skill. Oftentimes this skill and training was confined to certain families, passing from father to son.

It was not long however until still further complicated problems arose, making it necessary for the workman to learn more and more by reading recorded reports of the solutions of some of the problems confronting him rather than depending on his own ability and experience. He was thus able to accomplish more and have time himself to give to the solution of some of the new and more difficult problems which he had encountered.

By collecting the information covering the solution of these problems, a literature was gradually developed. Since the solution of most of the problems involved the use of some of the sciences and since the applications affected so many of the citizens, more and more people became interested in the study of science. Schools began to develop, though their progress was quite slow. It was not until the early graduates had been out of college for some years and had demonstrated the value of such college training that the growth in number of schools and in number attending showed much increase.

With the application of science to man's comfort and pleasure, the demand for men trained along this line increased quite rapidly, so rapidly in fact that it is no wonder that the curricula comprised so much of a purely technical nature. In the early days the engineer's duties were very largely in the field of design which tended to confine his activities to the field of materials and required him to have little contact with men.

The success of the engineer in the application of the principles of physics, chemistry and other sciences, using our various natural resources, has been rather phenomenal and has had tremendous effect on our living conditions.

This was hastened by the invention and successful application of the steam engine which made power available in sufficient quantity and at places suitable for the manufacture of articles in large quantities, and at a cost within the range of the purchaser. The coming of electricity as a means of transmitting and utilizing this power has had a tremendous influence on our industries and in many cases has revolutionized the early applications of power. Wages increased as a more intelligent worker was required. This made it possible for more people to obtain many of the things they so much desired but could not heretofore afford. Large manufacturing plants began to develop, necessitating the concentration of people in a small area. The result was not only the development of large industrial cities but also large distribution centers.

The engineer has tried to provide the means of improving living

conditions and satisfying human needs. The automobile, truck, airplane, and improved railroad and steamboat have greatly speeded up transportation as well as made it more comfortable. The use of the telephone, telegraph and radio has made the whole world neighbors; the electric light and artificial gas, water, sewerage and many others have added to comforts of the home; the moving picture, radio, and talking machine have added pleasure as well as opportunity for improvements; better roads, better buildings, have been provided. These and many others have been provided by the scientist, inventor and engineer.

The changes which have come as a result of science and its application have been so rapid that the whole social and economic life of this country as well as the other countries of the world has changed greatly and changed so rapidly that adjustments have not kept pace with engineering developments, so that we now have more or less social and economic disorder. The engineer has been to a large extent responsible for these rapid changes which are an outstanding example of his technical ability and efficiency. He should therefore feel some responsibility in helping to solve many of the problems which have arisen as a result of his work.

Before the industrial era the curricula of our colleges consisted largely of the humanities, history and philosophy. The majority of those taking such courses were those preparing for the clergy or those who were to be rulers. This type of education seemed quite satisfactory for them but with the development of the great industries of today a change was necessary in our education and changes will always have to be made as long as science and industry continue to widen their fields. The value of this newer type of education has been questioned by many of those holding to the older type as the only way the mind could be given a high degree of training. Engineers and scientists on the other hand believe that the study of the scientific subjects may also train the mind to just as high a degree. I think it is coming to be more generally recognized that the mental requirements in the study of thermodynamics, electrical engineering, and the like are of just as high order as the study of these humanities.

There has been much misunderstanding of what is meant by culture and what is meant by a profession, so I think it may be well to give here a definition of these. Webster defines culture as, "The act of developing by education, discipline, etc.; the training, or refining of the moral and intellectual nature.—The state of being cultivated; especially, the enlightenment and refinement of taste acquired by intellectual and aesthetic training; the intellectual content of civilization; refinement in manners, taste, thought, etc.—Conversance with and taste in fine arts, humanities, and broad

aspects of science;—distinguished from vocational, technical, or professional skill and knowledge." Profession, "The occupation, if not commercially, mechanical, agricultural or the like to which one devotes oneself: A calling in which one professes to have acquired some special knowledge used by way of instructing, guiding or advising others or of serving them in some art."

In the past theology, law, and medicine have often been spoken of as the three learned professions though there are a number of other highly respected professions today on a par with them and ranking just as high as any of these. That which may be considered an humble calling today may be a high respected profession tomorrow. While cultural or humanistic studies have been usually considered as those which tend to develop the mind and character, the study of some of the sciences may just as well fit in with the definition as some of the so-called cultural studies.

In 1862 Senator Justin S. Morrill, of Vermont, sponsored a bill giving Federal support in the form of land grants for the purpose of founding institutions in each state of the union for the study of agriculture and mechanic arts. The passage of this bill may be considered the birthday of democracy in American higher education just as 1776 is for American political democracy. Chauncey M. Depew said in 1927, "Higher education today is infinitely better and furnishes more opportunities for life than it did when I entered college seventy years ago. When I graduated from college, it was either the law, the ministry, or medicine for the graduate. Today there are 3,000 occupations open to the college graduate." The liberal arts type of college which is supposed to develop the æsthetic taste has often been compared with the training given in our engineering colleges which the critics claim to be highly specialized. I wonder if some of these critics have made a careful study of the curricula of our engineering colleges.

W. E. Wickenden, Director of Investigation for the Society, after a thorough examination of the curricula in engineering more than ten years ago made the following statement: "American engineering students receive very little less than two years of work which would be entirely acceptable toward a degree in practically any college of arts and sciences." Since that time I am sure there has been an increase in humanistic studies in many of our colleges of engineering. The intellectual advancement depends much more on the student and the teacher than it does on the course of study. In his presidential address Dean Potter, at Schenectady, in 1925 says: "It has been the policy of the engineering colleges to develop reasoning power and arrive at truth by observation and experiment by study of such subjects as mathematics, mechanics and thermodynamics, electricity, etc. and at the same time develop in

the students the ability to understand and interpret correctly the ideas of others as well as a capacity for clear, logical thinking and concise and clear expression on their own part." In any college education the personal factor is of major importance. Some sage has said "To rub a brain with other brains is the best form of polish." And the quality of the polish will depend more on the quality of the individuals with whom the student comes in contact than on the course of study he pursues. At the Land-Grant Colleges meeting in Chicago in November 1923, Dexter S. Kimball, then Dean of Engineering at Cornell, made an address at one of the general meetings which impressed me very much, and parts of which I have never forgotten. Some of it is quite pertinent and I quote part of it as follows: "In these days of specialization every man must work in a somewhat limited field. In general the development so obtained does not give him skill or knowledge in any other field. But the affairs of men are many and varied and no man can be said to have a liberal view of humanity who does not know what its vital interests are. If, therefore, he is to be liberally educated he must keep himself informed as far as possible regarding all social, political and industrial movements. What, therefore, is vocational to one man is liberalizing to another. Latin and Greek may be strictly utilitarian to the archeologist while liberalizing to the scientists. A knowledge of some industrial pursuit will be vocational to the man who is making a living thereby, while a knowledge of the same art may be very liberalizing to a divinity student. The student of the humanities and classics can lay no claim to liberal education unless he knows something about the great fields of science and industry and the human interests involved that surround and affect him for good or ill on all sides. The student of science and the man interested in industry will find many things made plainer and his horizon greatly broadened by studying the recorded experience of those who have preceded him. No man can lay claim to a liberal training if his education has narrowed his vision so that he sees only the good in his own particular field."

Before the days of great industrial development many of the classical studies may be considered to have been vocational to the student of that day since these were the things he used in his daily work. Since the coming of the industrial era there has been great change in our social and economic order as well as our political organization. Our civilization enjoys greater physical comfort than has ever been known in the history of the world. We also have more desire for pleasures and more with which to satisfy them is demanded not only by the few but by all. Many of us can recall the day when education, especially college education, was

only in the reach of a comparatively few and those few were usually those who could afford it financially and generally those whose families had had similar advantages. Generally speaking, the masses expected neither a great deal of physical comfort or pleasure nor educational opportunity. Now few who have the mental ability and an earnest desire and are willing to work for it, are denied the privilege. The average citizen today demands the main comforts of life. The luxury of today becomes the necessity of tomorrow. All of this is a result of our modern industrial methods and was never anticipated when the humanities and classical studies were about the only things found in the college curricula. The philosophy of life was different then than now. It is not enough then for us to study the works of the old philosophers but it is necessary also for us in our educational system to study the changes that have made our civilization so much more complex than in the days before our great industries were developed.

We are living in a day of change. We see changes in almost everything. Our engineering curricula are continually being revised; new engineering courses are added and others dropped and the content of others made quite different. Even the humanities change with the times and will continue to change as our civilization advances. Educational methods have also changed, methods of presentation being quite different than those used years ago. History is no longer a study of dry facts, with dates and battles, giving the principal generals, number of forces in combat with casualties on each side, and finally the result of the battle. The study is rather of the events leading up to war and the effect of the outcome of the war on not only the countries involved but on civilization as a whole. The study of history today is rather of conditions leading up to changes that have taken place along with the effects of such changes on future events. I am sure many of us who were subjected to the old system would find much more pleasure in its study under the present method as well as derive more good from its study. Such studies of past occurrences may help to guide us in the solution of future problems that may arise, and never has there been a time when there was greater need than now for guidance in the solution of our present day problems, which are more world wide and more international in character than ever before in the history of the world.

The social problem today is one of great perplexity and will only be solved when scientific methods are used. The economic problem is also difficult and one on which there is great disagreement. Here again we need to get all the facts in the case and apply the methods used by the scientists in reaching a sound conclusion.

Because of our changed social and economic order, many prob-

lems in government have also arisen. As a citizen and as a leader the engineer must accept his part in helping to solve the many problems that arise. I believe the world is looking to him more today than ever before for his leadership. President Coolidge, in addressing the American Association for the Advancement of Science, made the following remarks which apply to the engineer as well as the scientist: "The future of civilization is well-nigh in your hands. You are the wonder workers of all ages. Those of us who represent social organization and political institutions look upon you with a feeling that includes much of awe and something of fear, as we ask ourselves to what revolution you will next require us to adapt our scheme of human relations. But we know you are animated by a profound purpose to better the estate of men." It is the duty of the college then not only to train men who will become capable engineers but men who will take an interest and leading part in our social and economic readjustments.

In a bulletin of the California Institute of Technology is found this statement: "There is no good reason why engineers should be more limited in the range of their human interest than are men of any other profession. Many of them, as a matter of fact, are not. On the contrary there are those who have shown the world that scientific competence can be vivified by imagination and technical skill illuminated by humanism. They are the men who transcend the bounds of their calling. And it is to such that the world must look for leadership in all branches of technology, for new ideas and broader conceptions, as well as for the linking of science with religion, with government, and with the vast network of human relations which we call modern civilization."

While it has been difficult to impress the engineering student and in many cases the engineering faculties with the need for the study of the humanities there is considerable evidence of greater interest today than has ever been shown before.

As long as engineering dealt primarily with materials the student interest was in nearly all cases confined to a study of those things he felt would be of direct help to him in his vocation. Since the human element has entered in so great a degree, when engineers are dealing more and more with men and dependent more and more on men, a study at least of some of the humanities is now a necessity and may hardly any longer be considered as cultural subjects but rather vocational ones. Economics enters all problems of design. In addition to the economic problems directly connected with the design the engineer should have a knowledge of economics in order that he may understand modern industrial problems. By a study of history he may learn something about the problems of humanity in the past, and thus be in better position to help solve the problems

of the future. Because of the radical changes in our social order a study of sociology and psychology is becoming more and more important.

It seems to be the general consensus of opinion, though there are many who do not concur, that four years are enough to spend in undergraduate work. How then can time be found for the addition or extension of these humanities or cultural subjects, for certainly the curricula contain so much now that further additions are out of the question? Some of our technical subjects may be abbreviated and some of the applications which involve the same principles may be eliminated entirely. We can only hope to give a limited time to these humanistic subjects. We can not hope to give the work required for an A.B. degree and an engineering degree in this limited time. These humanistic studies must be given rather with the idea of creating an interest in them and showing their needs to engineers of today and particularly to the engineer of the future. We can never hope to do major work in such courses and at the same time give the time necessary to subjects that must of necessity be covered in the four year course of engineering.

When we think of engineering education we usually think of the regular four year undergraduate courses in some college of engineering, sometimes followed by another year or two by a small percentage of the graduates. As a matter of fact, the education of the engineer extends over a much longer period and more though should be given to the period prior to entrance to college as well as to the years following graduation.

In the home the child may be taught much that goes to make up culture. It is here that he may be taught courtesy, good manners, and also here that may be developed an interest in and an appreciation of good music, art, and literature. In the case of music or art this may be done by study or by making it possible to hear good music and see good art. While one may learn to appreciate these without formal study, some study would give much greater appreciation and pleasure. The work Damrosch has been doing over the radio for the school children has had a remarkable effect. Many school orchestras and bands have been formed as a result and in many cases a teacher provided. Because of his interest and the wonderful personality of Damrosch the children of this country should grow to have a much greater appreciation of music.

In the case of literature, proper supervision of the child's reading is very helpful. The radio and the moving picture may be used to advantage in the future if proper programs are demanded. Some improvement has been shown in the moving picture in the last few years.

In the schools today we find many of the subjects taught that were formerly found in the liberal arts college, such as Latin and modern languages, history and some of the general sciences.

Children reared in cultural homes learn to speak correct English without knowing the grammar and as a rule students from such homes rarely have trouble with this subject in the high schools and colleges and often get on better in other subjects because they are able to read understandingly. Students who have not had this advantage may in some instances be taught to write correct English but rarely to speak it regardless of the time given to its study in college. The only remedy seems to be two or three generations under improved home conditions.

In college we are confronted with some who have had these early social and cultural advantages but by more who have not. It is our desire to help these as much as possible but even in the four years of college many of these will show little improvement. We may offer the opportunity but not every one can avail himself of it, some through lack of interest and some through lack of ability. If the student will show persistent effort in college and continue in the years following much improvement may be made.

The study of liberal subjects does not necessarily lead to a liberal education just as the study of engineering subjects does not necessarily make an engineer. Some men with no college training may become liberally educated and some may become outstanding engineers who have not had a chance of training in an engineering college. It was Dean Kimball who said the college has a responsibility in developing the desirable characteristics inherently in us and suppressing those not desirable.

In the building of a curricula of engineering we must look at the product we are trying to turn out and, taking into account the product we receive from the high school, plan to give not only the various courses we think will give us that product but also try to allot the necessary time to each, and above all, arrange the content of these courses so they will have the proper relation with each other with the idea always in mind that each is doing its share in the development of the finished product. A painted picture has in it a number of colors with a definite amount of each color but most important of all is the relation of these colors, one with the other, if the desired effect is to be had in the finished picture. Are not many of our curricula simply a collection of courses, each of which may be good but with little thought as the relation of one with the other? The technical courses are usually arranged with some sequence in view, but can that be said of the cultural? It is not quantity but quality we should stress. We should strengthen the instruction in a limited number rather than by adding new

departments and by trying to cover too broad a field. Have we given enough attention to the selection and training of our teachers of cultural subjects? Since engineering students are not naturally attracted to these subjects we need men who not only know their subject, but men who can make their courses so attractive that the students will become interested in them. Can we not by coöperation get a better understanding on the part of each teacher, whether he be a teacher of an engineering subject or a cultural subject, of how his course fits into the general scheme of the education of the engineer?

If the engineering teachers can be made to realize the part the engineer has played and is to play in a much greater measure in our future civilization, they can be of great help in creating among the students the need for their interest in these cultural studies. They may also do considerable instruction themselves along with the teaching of their engineering subjects. Economics particularly lends itself to such teaching. The engineering teacher should also bring to his students the fact that the professional engineer should be able to be at ease whether he has on overalls, business suit, or dinner coat; with workmen and with men in other walks of life as well as with his fellow engineers; in the presence of ladies as well as men. He should be able to converse at least with some intelligence about music, art, or literature, as well as economics and politics.

If our future engineers will pay more attention to these things they will not only rise to higher positions themselves but will exalt the engineering profession so that the professional engineer will receive greater recognition and eventually increase his earning capacity.

ADDRESS OF WELCOME

By F. C. BOLTON

Vice-President, A. & M. College of Texas

We at the A. & M. College of Texas feel honored that you are with us here this week. We welcome you to A. & M. College, to the Texas section, and to the state of Texas. This is a happy occasion for us, because regardless of what you may get out of the visit, we expect to get a great deal. We are fortunate in having a larger part of our faculty here than you can have, and we know that when this meeting is over we will have gotten more from it than you can possibly get. It will be a source of much information and of great inspiration to us to have spent this week in conference with you. We hope you will find some things in our Texas institutions worthy of your emulation. We know you are going to bring us many new ideas. In extending this welcome, I should like you to feel that I am doing this for the College as a whole. Every division and department of the institution joins with the School of Engineering in wishing you a pleasant week here with us.

I said I was glad to welcome you to Texas. We are proud of this state of ours. It has a glorius history, one in which we take a great deal of pride. We are told that the first white man set foot on Texas soil in 1528, just thirty-six years after Columbus discovered America. Since that time, the flags of six nations have flown over this country. In the early days it was French and Spanish, followed by the Mexican flag when that nation threw off the yoke of Spain. Then came the Lone Star flag of the Texas Republic. Then the Stars and Stripes, with an interlude of four years under the Stars and Bars of the Southern Confederacy.

The two great Americas are divided geographically at the Isthmus of Panama, but politically and racially the Rio Grande River is the dividing line. At the beginning of the nineteenth century, three nations undertook to extend their influence over Texas—Spain, France, and America. France withdrew with the Louisiana Purchase in 1803, leaving Texas as the northernmost boundary of Latin America. Due to the farsightedness of such men as Moses and Stephen Austin, and the heroism of Sam Houston, and a thousand others, Texas now lies within the southern border of Anglo-Saxon America.

Texas has a variety of climates. We also have a variety of soils.

Rainfall varies from about fifty inches in the east to less than ten in the west. Elevations run from a few feet above sea level on the coastal plains to three or four thousand feet in west Texas, with some peaks that extend above eight thousand feet. Many people in the country think of Texas as a sort of treeless plain. We do have broad expanses of country in which there are few trees. On the other hand, the pine timber belt of east Texas covers an area as large as the state of Indiana. The lumber and timber industry contributes very largely to the products of the state. In mineral resources we have oil, gas, lignite, cement, lime, salt, sulphur, iron, even a little bit of silver, and some mercury. Texas has been and is regarded as a great agricultural and livestock state, and yet in the last two years the value of manufactured products has exceeded that of agriculture due, of course, in large measure, to the manufacture of products from petroleum. Oil in commercial quantities is found in 115 of the 254 counties of Texas.

Our Texas industries have been growing steadily. Manufacturing fell off in the depression, of course, but it is interesting to note that by 1935 the quantity of manufactured products exceeded that of 1929. I say "quantity," because I believe the value in dollars was still low on account of the difference in price levels. We have fuel well distributed over the state, lignite in a good many places, gas available almost everywhere, and oil is of course available also. Electric transmission lines cover the state and make electric power available anywhere it is needed. Formerly, we made little use of our water power or of our rivers, largely because the rainfall is seasonal and it is rather expensive to provide the necessary storage reservoirs. In recent years, however, we have made plans for harnessing some of these rivers, three of them in particular. The Colorado River has four dams which are being built primarily for flood protection, but which will incidentally furnish considerable water power. These dams vary in length from 1,500 to 11,000 feet, and in height from 63 to 193 feet. The Brazos River has one dam that is just being started, and twelve others that have been planned, and which we hope eventually to have. They are more largely for the protection of the lower reaches of the river. The Red River, on the north, has not progressed very much beyond the planning and the survey stage.

I think you will be interested in our Texas colleges. The publicly-supported higher education system consists of the University of Texas at Austin, the Medical College at Galveston, which is a branch of the university, the Texas Technological College at Lubbock, College of Arts and Industries at Kingsville, School of Mines at El Paso, the Women's College at Denton, seven teachers' col-

leges, and the A. & M. College system which consists of this college, the two junior colleges, and the College for Negroes. In addition, we have a number of excellent private and denominational institutions. Student enrollment in the colleges of Texas runs about 50,000. Of the colleges, seven senior institutions and two junior colleges give engineering work.

The publicly-supported institutions are supported primarily from appropriations. You have probably heard that A. & M. College and the University of Texas are very wealthy. That is a mistaken impression that gets around. The two institutions do profit from an endowment resulting from two million acres of land set aside for that purpose a number of years ago. From the oil that has been discovered and is being produced on that land, we are building up an endowment. That endowment now totals about twenty-six million dollars. Various estimates have been made as to how much oil there still is in the ground. That is a guess. We cannot spend the principal, but do have available ordinarily the income from the investments. It so happens, however, that both A. & M. and the University borrowed from the fund in order to erect some much needed buildings. A number of those that you see around here were built from that fund, and it is taking all the income now to repay that loan to the fund. So just at present we have no available income from it, but after the buildings have been paid out we will again receive the interest for such part of the operations of the institution as the legislature may designate.

Perhaps it is not inappropriate; at any rate, I should like to take this occasion to express my appreciation to the local committee, for whatever has gone off according to schedule since you have been here has been due to the work of Professor H. C. Dillingham, chairman of that committee, and for the untiring efforts of every man and woman connected with the college who have tried to foresee the needs as much as they could and be ready to take care of you. I hope, while you are in Texas, you may visit some of the other colleges. I think you all know that the University of Texas is hoping to have and expecting to have many of you come over Friday to look at that institution. You will find it well worth going over to see. They have built a great institution there.

I hope also, while you are in Texas, you may see some of the spots that are sacred to Texans, spots that have meant so much in the early history of the state. They tell the story that a few years ago a former President of the United States was held in San Antonio for a few hours between trains, and some friend suggested that he go out and see the Alamo. Much to the disgust, I thing I might say, of good Texans, his reply was, "What is the Alamo?"

I hope when you go back home you will be able to tell more about it than that. I could give you a lot of figures about the size of Texas. I could tell you that in Texarkana you are closer to Chicago than you are to El Paso, but if these loyal Texans that are on our faculty have not already told you that, they have not been living up to their responsibility.

Let me say in conclusion that we are just delighted to have you here. We hope your visit may be very pleasant and, whether you enjoy it or not, we are having a good time.

ADDRESS

By THOMAS O. WALTON
President, A. & M. College of Texas

May I add my word of appreciation and thanks to the executive officers of this Society and others who had to do with bringing this great convention to the Southwest and Texas, and more particularly Texas A. & M. College. It is a great honor for this institution, Texas University, and other institutions of higher learning in this state to entertain this distinguished group of educators and research workers brought from every point of the compass within these United States.

May I call your attention to a fact that I am sure is familiar to most of you, but one that perhaps cannot be overemphasized. It is that with the passage of the Morrill Act in 1862 there was brought a new educational philosophy to this nation and probably to other nations. Prior to that period, classical education had been considered about the only worthwhile enterprise in the general educational field. Classicists had the view point that probably it might be very well worth while to give man some instruction in manual training, but they had not looked upon the great field of engineering and mechanical arts that this group represents as worthy of the designation of an educational program, or an educational program designated to train men in these fields. There was a good deal of skepticism in the minds of many educators at the time the Congress of the United States, and then the states following, began to open institutions dedicated to the training of men and women in the general field of agriculture and engineering. I suspect there was some shaking of heads in certain academic circles at that time, and that there was a good deal of doubt in the minds of men who were thoroughly honest and thoroughly sincere in their conviction as to whether the government of this nation had not made a mistake in encouraging a program of education in fields that seemed so commonplace and so very vitally and directly related to the everyday, workaday affairs of man.

Seventy-five years have come and gone since the passage of that important piece of legislation. One by one the forty-eight states have made provision for meeting the intent and purpose of the Morrill Act. I am assuming this morning that the public generally must have been well convinced long ago that there is a legitimate and proper field for technical and technological education

because, if I am correctly informed, there are about 150 or 155 engineering schools offering degrees in the various fields of engineering within the United States, and the good Lord only knows how many schools offering degrees in agriculture and in related fields. The passage of the Morrill Act and the encouragement thereby of technological education not only brought into the field a new philosophy of education, but brought directly to a people an opportunity to have prepared for them a type of leadership that was sorely needed both in industry and in agriculture.

I am not qualified to instruct engineers, deans, presidents, and what-not as to how they may most efficiently and effectively carry on their program of teaching or research. But I greatly fear that we have not given as much thought as we might have given to the duties and responsibilities of the trained engineer to society. An eminent engineer has estimated that seventy-five per cent of an engineer's chances to succeed rests not upon his technical training or his proficiency as an engineer, per se, but upon those qualities and qualifications that we usually classify in the general realm of personality. You know quite as well as I what is included in personality. First, of course, it is the man's physical make-up, and then his general character, his ability to meet men, his ability to inspire confidence and to lead men, and his social consciousness.

We are hearing a great deal these days about the responsibility of the engineer to society. Frankly, I very greatly fear that we who have been training leaders to function in field of engineering have not thought enough about the responsibility of the engineer to his fellowman. I am of the opinion that some of our present difficulties may root back into our failure to develop the right viewpoint in the men who have been trained in the technological institutions, and particularly in the schools of engineering. The engineer has thought far too frequently and too much of what he might sell his services for, rather than to what degree he can, through his talent and his ability, render not only a service to self but a service to society. I believe there is coming an understanding and consciousness upon the part of men engaged in engineering education that perhaps we have been somewhat lax in our duties and responsibilities to our students and to society, because we have failed to develop the seventy-five per cent of the man's talent and to inculcate in him a desire and a purpose not to sell his services to the highest bidder, but rather to make his services count for the most he can for society.

This may sound like a peculiar doctrine, and perhaps it is. Yet, society in America is sick; industry in America is sick; but if those of us who have occupied positions of leadership, the trained engineer, the trained agriculturist, the trained college leader, had fully

discharged our duties and responsibilities, we might have a different picture in America today. Too often the college president, or the teacher, has felt if a man has come into the institution and, under his influence, has developed into a great technical engineer, he has discharged his whole responsibility. Many of us are coming to have very great doubts whether that is 100 per cent true. We know now that we have an obligation for the performance of our product, for the influence of his life upon society.

I was about to say a moment ago that I would advise all deans and professors, to go into politics, not in the sense of partisans but in the sense that we shall give some measure of guidance to those who come under our influence to the end that they may function efficiently and well in society as citizens.

We need to give a good deal more attention to the whole problem of student guidance in our institutions of higher learning. I know there are those in this group who are far better qualified than I to make suggestions concerning student guidance. You are giving consideration to those problems. I do not think a college or a university owes it to a young man to provide a wet nurse during the four, five or six years of his college career. I do think it would be tremendously advantageous to the institutions, to the students, and to the public generally if we could help the young man and young woman entrusted to our care for training to determine a little bit more definitely and a little more positively what fields of endeavor they should enter upon.

I think we have trained some supposed engineers, or alleged engineers, in this institution who will never reflect a very great credit upon themselves, upon the institution, or render a very great service to the state or to society. They are conscientious men and we admire them for their stick-ability and their purpose, but their talents might well have been directed into other fields, where they would have a greater opportunity to succeed, first, and have a still further and greater opportunity to render service to society. I am not at all certain but that engineering faculties might not spend just a little time profitably in the beginning of each session in trying to find out more about the qualities and qualifications of their freshmen to master the science of engineering. Some institutions have met this problem by establishing efficient departments of personnel and guidance, but the vast majority of the engineering institutions throughout this section of the country have not made provision for that service to the degree that it should be provided.

May we hope that, by concerted action throughout the engineering schools of this nation, we may bring to the consciousness of the young men we train the fact that they really owe a debt to society. I am not at all in sympathy with the doctrine that has

been announced in this state over and over again, namely, that the state owes every worthy boy and girl an opportunity to secure a higher education. There are a great many Texas people who hold to that theory. I do not. I do not think the state of Texas owes my son, or yours, a penny. All that she owes to my boy or to yours, or my girl or yours, is a fair, a just, an efficient, and an economical government. Texas does not owe to her sons and daughters, in my humble opinion, an opportunity to secure an education at public expense, but Texas does owe it to herself to make provision for every worthy, ambitious and capable young man and young woman to prepare and equip himself or herself to function as a helpful and constructive force among the citizenry of this great commonwealth.

I hope we may turn our thinking around a bit and bring to the consciousness of the young men and young women, for whose training we are responsible, an understanding of their obligations to society. If men and women trained in American colleges and universities were all thinking straight today, and if they had been thinking straight during the past twenty-five years and making their influence felt constructively, America, the great nation she is, would be a greater nation and her future would be assured.

I congratulate you upon the opportunity that you have to serve. I congratulate you upon the splendid manner in which you are discharging your duties and responsibilities. I hope I may have the pleasure of joining you and helping to make the training of engineers in the institutions of higher learning in this section more helpful, more effective, and more worth while.

MINUTES OF COUNCIL MEETINGS

June 27–30, 1938

The reports of the Secretary and of the Treasurer were read and ordered printed. The secretary was instructed to write to the treasurer, Mr. W. O. Wiley, expressing the regret of the Council that he could not be present at these meetings.

Institutional Members.—R. A. Seaton presented the following report of the Committee on Institutional Members, which was accepted:

Within the past year your Committee on Institutional Membership, in accordance with Council's action taken at the annual convention in Cambridge a year ago, prepared and recommended to Council a classification of the institutional members of the Society into active institutional members and associate members. This classification was approved by Council by letter ballot and was published in the annual Year Book issued last February.

Applications for institutional membership were pending a year ago from: Connecticut State College, Fenn College, Lewis Institute, Northwestern University, Scranton-Keystone Junior College, Los Angeles Junior College, Texas College of Arts and Industries, University of Santa Clara, and Wayne University. Of these institutions Connecticut State College, Northwestern University and Wayne University requested that their applications be tabled when it developed that they are not now eligible for active institutional membership. The University of Santa Clara was recommended by the Committee for active institutional membership, and Fenn College, Lewis Institute, Scranton-Keystone Junior College, Los Angeles Junior College and Texas College of Arts and Industries were recommended by the Committee for associate institutional membership. These recommendations were approved by Council by letter ballot. Fenn College later resigned its membership.

Other institutions elected by Council within the year to associate institutional membership upon the recommendation of your Committee are: Ohio Northern University at Ada, Ohio; Polytechnic College of Engineering at Oakland, Calif.; and Kansas State Teachers' College at Pittsburg, Kansas. An application was received from the Eastern New Mexico Junior College, but it has

as yet failed to furnish the necessary information to qualify for membership.

At the beginning of the year the Committee found that of the 107 institutions in the United States, which appeared to be eligible to active institutional membership in the Society, all but 17 already held membership, and the application of the University of Santa Clara was pending. Letters were written to each of the other 16 non-members and applications for membership were received from 13 of these institutions, including University of California, Clarkson College of Technology, Howard University, Montana School of Mines, University of New Mexico, New York State College of Ceramics at Alfred University, Norwich University, University of Rochester, University of Southern California, Union College, Virginia Military Institute, Webb Institute of Naval Architecture, and West Virginia University.

Of these 13 applicants, nine were elected by letter ballot of Council, and the other four are recommended to Council for election to active institutional membership in the Society at this meeting. These four are:

Clarkson College of Technology
Montana School of Mines
New York State College of Ceramics at
Alfred University
University of Southern California

If these applicants are elected by Council as recommended, there will then be only three eligible institutions in the United States that are not active institutional members of this Society. These three are: College of the City of New York, Darmouth College, University of Nevada.

(Council elected the four institutions as recommended.)

Of course, additional institutions will probably qualify for active institutional membership as the ECPD accrediting program is carried further, and some institutions now holding active institutional membership may become disqualified for such membership. Your committee recommends that an active effort be made to induce all eligible institutions to become active institutional members, and that applications for associate institutional membership from those institutions that can qualify for that grade of membership be welcomed.

1940 Meeting.—The Committee on Relations with Other Engineering Societies recommended that the 1940 meeting of this Society be held at the University of California at Berkeley. Recommendation adopted.

The Publication Committee together with H. J. Gilkey will study the occupational and geographical distribution in the year book.

The Society will act as one of the sponsors, without financial responsibility, to the **International Management Congress** to be held in Washington, D. C., September 19–23, 1938.

A. E. C. and E. C. P. D.—C. E. Davies was elected one of the representatives of the Society on the American Council on Education; and C. C. Williams one of the representatives of the Society on the Engineers Council for Professional Development.

Council approved the holding of a session on **hydraulics and sanitary engineering** at the University of Iowa in 1939; this session to be under the auspices of the Civil Engineering Division of the Society and without expense to the Society.

Council approved a **contingent fund of $300.00** from which, upon approval of the Executive Committee, the traveling expenses of officers of the Society, other than the Secretary, be paid. This is intended to apply particularly to those officers who represent the Society at sectional meetings.

Dues.—Council approved 10 per cent discount to individual members who pay their 1938–39 dues on or before January 15, 1939; sections then to feel free to ask their members for this saving to pay the expenses of the section, that for every member sending $5.00 dues to the secretary's office, 50 cents be sent to the section to which the member belongs.

English.—H. L. Creek reported progress of the survey of English being conducted by that Committee under a grant from the Carnegie Corporation:

The investigation of instruction in English in engineering colleges which is being conducted under a subsidy from the Carnegie Foundation has made substantial progress. At a meeting of the Committee on English at the University of Pittsburgh in November, 1937, which was attended by all the members, the objectives were discussed and plans laid. A sub-committee consisting of A. M. Greene, J. L. Vaughan and H. L. Creek was appointed. This committee has sent informal letter-questionnaires to the following groups of persons: 1, all deans and presidents of the institutional members of the Society for the Promotion of Engineering Education; 2, all departments of English in the same list; 3, about 800 graduates of representative institutions in this list; 4, employers of engineering graduates and personnel men associated with large industrial organizations; 5, instructors in English who are teaching engineering students. Answers to these letters have been gratifyingly detailed. The deans of the engineering colleges have been especially helpful and departments of English have also contributed a great deal of valuable information. Enough material

has also been received from the other groups to enable the committee to study the effectiveness of present instruction and the desires and needs of industry and of engineering graduates.

To consider this material and to prepare chapters of the report a number of persons have been selected. For example, H. P. Hammond is to write the vital chapter on "The Function of the Department of English in the Engineering College." It is expected that most or all of these chapters will be ready for publication during the next year. Another meeting of the Committee on English will be held to make recommendations, which are to be embodied in a final chapter. The indications are that there will result a number of definite suggestions regarding methods of teaching, the proper organization of departments of English and speech, and the selection and training of suitable instructors in English for engineering colleges. Effective plans in use in some of the institutions of the country are also to be given particular attention. The widespread interest in the study that has been manifested makes us confident that any suggestions from the committee will receive the consideration of engineering colleges generally. It is hoped that a clearer conception of the possible contributions of a department of English to engineering education will be gained and that the steps necessary to enable English instruction to accomplish what is possible will made clearer.

Of the $2500 grant of the Carnegie Foundation, more than $600 has already been spent—nearly $300 to pay the expenses connected with the meeting of the Committee on English in November and the remainder for supplies and clerical expenses. At least $1000 will be required to pay the cost of printing and distributing the report. One more meeting of the Committee on English will be necessary and additional expense of a clerical character will probably amount to $300 or more. An effort is being made to keep down the cost of clerical services and committee meetings so that there may be an ample fund for the report itself and for its proper distribution.

Sections and Branches.—Council approved the following report of G. W. Case, Chairman of the Committee on Sections and Branches:

The title of the chief officer of sections and branches is to be "Chairman" and the title of "President" is to be reserved for the parent society.

Council approved the formation of a section in upper New York; the extension of the Colorado-Wyoming Section to include New Mexico and to be called the Rocky Mountain Section; and the formation of a branch at Cornell University. Sections have now been established in all parts of the United States except North

Dakota, Maryland, and the District of Columbia. Sections in these latter areas are likely to be established in the near future.

The importance of the action of Council that when $5.00 dues is paid by a member on or before January 15, 1939, 50 cents of it will be sent to the section to defray the expenses should be emphasized by chairmen and secretaries at meetings of their members and through other contacts, personal or otherwise, which they have with their members. This plan should relieve secretaries of the sometimes unpleasant task of obtaining money to defray the expenses of sections, and in addition furnish a convenient method by which members can contribute to the cost of operating his section.

It was further voted by Council to include in the budget of the Society an amount to defray traveling expenses of officers of the Society to appear on the programs of sections. This amount is not large but it is hoped that it is sufficient to enable the parent Society to have this representation on the programs of each section at least once in three years.

Two-Year Terminal Plan.—B. R. Van Leer reported for the Committee on the Two-Year Terminal Program. Upon motion the report was accepted, the committee discharged with the thanks of the Council, and the Secretary was instructed to express appreciation of the Society to the Office of Education and to Dr. W. C. John for the work done by them in connection with this committee.

Council approved the appointment of a special committee to study and report on the situation of unionization as it affects engineering graduates and engineering education; the report to be presented to the Council or to the Society or to be published at the discretion of the Executive Committee. The committee is to be composed of one man from industry and two from colleges of engineering.

E. C. P. D.—Chas. F. Scott reported relative to the activities of the Engineers Council for Professional Development as follows:

E. C. P. D. is best known to S. P. E. E. through its accrediting of engineering curricula. Another vital relationship is in the after-graduation or experience period of the young engineer. The schools prepare him for it; E. C. P. D.'s Committee on Professional Training aims to aid his development (through suggestions, reading lists, articles in engineering society publications and the like); N. C. S. B. E. E. (National Council of State Boards of Engineering Examiners) determines when his development merits a certificate of registration. The requisite is normally a diploma and experience satisfactory to the Board. E. C. P. D. has asked what kind of experience is satisfactory and what should the young engineer aim to acquire in the School of Experience. N. C. S.

B. E. E. has delegated this problem to a committee on Qualifying Experience. Its report, now in preparation, will be significant to the engineering schools. As the training for the profession of engineering (unlike other professions) supplements a short formal period in school by experience often undirected and dependent for its quality on the individual, it is important that he should have at graduation an understanding of the situation, an outlook and an attitude which enable him to make the most of his opportunities. I happen to be closely connected with the activities of E. C. P. D. as its chairman, and with N. C. S. B. E. E. as chairman of its committee on Qualifying Experience, and I realize how S. P. E. E. may serve its graduates by better qualifying for the experience period in which the foundations of careers are laid. Each stage in the progress of the engineer beginning with high school should prepare for the next, both in knowledge and in outlook and attitude.

Budget.—The following budget for 1938–39 was approved:

Receipts:			
Current dues:	136 institutions	$ 2,040.00	
	2,400 individuals	10,760.00	$12,800.00
Back dues			700.00
Advertising			2,500.00
Sale of publications and emblems			500.00
			$16,500.00
Disbursements:			
Meeting		$ 800.00	
JOURNAL and *Proceedings*		7,000.00	
Committees and conferences		500.00	
Contingent fund		300.00	
Honorarium of Secretary		2,000.00	
Clerical assistance		4,000.00	
Sundry printing		300.00	
Postage, telephone and telegraph		600.00	
Dues		350.00	
Travel, Secretary's office		400.00	16,250.00
Estimated surplus			$ 250.00

Members.—The following members were elected:

Ayers, Maurice T., Instructor in Machine Design, Cooper Union, New York City.

Carey, Robert H., Instructor in Mechanics and Materials of Construction, The Pennsylvania State College, State College, Pa.

Cobine, James D., Instructor in Electrical Engineering, Harvard Unisity, Cambridge, Mass.

DeMoyer, Robert, Associate Professor of Civil Engineering, Pennsylvania Military College, Chester, Pa.

Graesser, Roy F., Professor of Mathematics, University of Arizona, Tucson, Ariz.
Horrell, Maurice W., Instructor in Electrical Engineering, Kansas State College, Manhattan, Kansas.
Housel, Williams, Associate Professor of Civil Engineering, University of Michigan, Ann Arbor, Mich.
Lockwood, H. J., Professor of Electrical Engineering, Manhattan College, New York City.
Martin, Frank L., Professor of Civil Engineering, Pennsylvania Military College, Chester, Pa.
McIlwain, Knox, Associate Professor of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.
Miner, Douglas F., George Westinghouse Professor of Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.
Neugebauer, George H., Instructor in Machine Design, Cooper Union, New York City.
Normand, Hal C., Instructor in Engineering, Schreiner Institute, Kerrsville, Texas.
Raeder, Warren, Associate Professor of Civil Engineering, University of Colorado, Boulder, Colo.
Robertson, James E., Assistant Professor of Drawing and Design, Michigan State College, East Lansing, Mich.
Scofield, J. Harry, Associate Professor of Mechanical Engineering, Colorado State College, Fort Collins, Colo.
Sherman, Victor L., Associate Professor of Mechanical Engineering, Lewis Institute, Chicago, Ill.
Siskind, Robert P., Associate Professor of Electrical Engineering, Purdue University, Lafayette, Ind.
Smith, Thomas D., Assistant Professor of Civil Engineering, University of Delaware, Newark, Del.
Specht, Walter A., Instructor in Electrical Engineering, South Dakota State College, Brookings, S. D.
Stratton, William T., Professor and Head, Department of Mathematics, Kansas State College, Manhattan, Kansas.

Clarkson College of Technology, Potsdam, N. Y.
Montana School of Mines, Butte, Mont.
New York State College of Ceramics at Alfred University, Alfred, N. Y.
University of Southern California, Los Angeles, Calif.

MINUTES OF 46TH ANNUAL MEETING

The 46th annual meeting of the Society for the Promotion of Engineering Education was held at the Agricultural and Mechanical College of Texas, College Station, Texas, June 27–30, 1938; presiding officer, President S. B. Earle, Dean of Engineering and Director of Engineering Experiment Station, Clemson College, S. C. 984 members and guests were registered.

Conferences of the following groups were held all day Monday, and Tuesday and Wednesday afternoons: Chemical Engineering, Civil Engineering, Comprehensive Examinations, Coöperative Engineering, Drawing, Electrical Engineering, Engineering Research, English, Industrial Engineering, Instructional Methods, Mathematics, Mechanical Engineering, Mechanics, Mineral Technology, Orientation of Freshmen, Physics, Professional Status of Graduates and Sections and Branches.

The first general session was held in Guion Hall on Tuesday morning, June 28. Colonel Dunn led the audience in the singing of America.

F. C. Bolton, Vice-President of the A. & M. College of Texas, welcomed the Society to the institution; President Earle responded for the Society. Thomas O. Walton, President of the College, addressed the Society; President Earle delivered the presidential address, "The Cultural and Professional Phases of Engineering Education." This was the keynote of the meeting. A. A. Potter, Purdue University, read his paper, "The Professional Phase of Engineering Education." The reports of the Secretary and the Treasurer were presented and ordered printed in the JOURNAL.

President Earle appointed a Resolutions Committee composed of H. T. Heald, Armour Institute of Technology, R. C. Disque, Drexel Institute of Technology, L. S. LeTellier, The Citadel, A. P. Poorman, Purdue University, and G. L. Sullivan, University of Santa Clara.

The second general meeting convened on Wednesday morning, June 29, and was devoted to the Cultural Phase of Engineering Education. Papers were read by J. W. Calhoun, President of the University of Texas; D. S. Kimball, Cornell University (read by John R. Bangs), and R. A. Seaton, Kansas State College. These papers were discussed by J. B. Thomas, Texas Electric Service Company, C. W. Crawford, A. & M. College of Texas, R. C. Disque, Drexel Institute, Charles F. Scott, Yale University,

C. J. Freund, University of Detroit, A. B. Domonoske, Stanford University, A. M. Greene, Princeton University, and A. L. Thomas, Alabama Polytechnic Institute.

The annual dinner was held in Sbisa Hall at seven o'clock with President Earle presiding. A. N. Talbot, University of Illinois, Chairman of the Nominating Committee, presented the following report. Upon motion the Secretary cast the unanimous vote of the Society for the officers and members of the Council:

For President: Karl T. Compton, Massachusetts Institute of Technology, Cambridge, Mass.

For Vice-Presidents:

Geo. W. Case, University of New Hampshire, Durham, N. H.; M. L. Enger, University of Illinois, Urbana, Ill.

For Secretary: F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

For Treasurer: W. O. Wiley, John Wiley & Sons, Inc., New York City.

For Members of Council to serve three years:

H. H. Armsby, Missouri School of Mines and Metallurgy, Rolla, Mo.
H. T. Heald, Armour Institute of Technology, Chicago, Ill.
Louis Mitchell, Syracuse University, Syracuse, N. Y.
C. A. Mockmore, Oregon State College, Corvallis, Ore.
W. B. Plank, Lafayette College, Easton, Pa.
Jas. S. Thompson, McGraw-Hill Book Co., New York City.
R. B. Wiley, Purdue University, Lafayette, Ind.

Geo. B. Thomas, Bell Telephone Labs., presented the report of the Committee on Lamme Award. The eleventh award was made to Robert Lemuel Sackett, Dean Emeritus of The Pennsylvania State College in recognition "of his work in coördinating the thought of industry and education for the improvement of their understanding of their mutual problem in the selection and development of potential leaders; of his intensive work within this field in his own state and adjacent states; of his influence in the development of the scope of engineering extension as a department of higher education; of his effective appreciation of the necessity of essential symmetry, the early intellectual, physical and spiritual growth of genuine leaders; and of his own high exemplification to his students of these essentials of character."

Dean Sackett was not present at the meeting and H. P. Hammond was asked to convey the medal to him. Later at a dinner in New York City Geo. B. Thomas presented the medal to Dean Sackett.

Karl T. Compton, President of Massachusetts Institute of Technology, addressed the Society on the work of the Engineers' Council for Professional Development's Committee on Accrediting of Engineering Schools.

The dinner was followed by a dance.

A meeting of the institutional delegates and the Council of the Society was held on Thursday morning at seven o'clock. Vice-President K. T. Compton presided. Seventy-one delegates answered the roll call.

O. M. Leland, University of Minnesota, presented the report of the Committee on Engineering Degrees. This was discussed by Thorndike Saville, New York University, L. E. Grinter, Armour Institute of Technology, A. M. Greene, Princeton University, H. P. Hammond, Pennsylvania State College and Vice-President Compton.

H. P. Hammond presented the report of the Committee on Accrediting Engineering Colleges of the Engineers' Council for Professional Development. This report was discussed by F. L. Bishop, University of Pittsburgh, K. T. Compton; Chas. F. Scott, Yale University, B. R. Van Leer, North Carolina State College, A. M. Greene; Louis Mitchell, Syracuse University, R. W. Sorensen, California Institute of Technology, and R. A. Seaton, Kansas State College.

The findings of these committees will be published in an early issue of the JOURNAL OF ENGINEERING EDUCATION.

The third general session was held on Thursday morning, June 30, with Vice-President F. C. Bolton in the chair. The theme of this meeting was the Professional Phase of Engineering Education with papers presented by W. R. Woolrich, University of Texas, P. H. Daggett, Rutgers University, and O. W. Eshbach, American Tel. & Tel. Co. The discussion was led by C. E. Davies, American Society of Mechanical Engineers, and Gibb Gilchrist, A. & M. College of Texas.

H. L. Dodge, University of Oklahoma, presented his paper, "Preparation of College Teachers," and T. H. Morgan, Worcester Polytechnic Institute, abstracted his paper, "A Program of Unification and Correlation in Engineering Education."

H. T. Heald, Chairman, presented the following resolutions which were adopted by a rising vote:

Be it resolved by the Society for the Promotion of Engineering Education in convention assembled at the Agricultural and Mechanical College of Texas:

1. That this body express its pride and satisfaction in the distinguished contribution that the Agricultural and Mechanical

College of Texas is making to engineering education, and express the pleasure it has given the Society to visit the college campus and observe the superior plant and equipment, and to meet the members of the accomplished staff.

2. That the Society convey to President Walton, Dean Bolton, and their officers, faculty and students, its congratulations on their high achievements and wish for them continued success in the service of the State of Texas and the nation.

3. That the Society make grateful acknowledgment of its profound obligations to the College for so generously and hospitably acting as host to the convention, and for making available for the use and enjoyment of guests its admirable facilities; and for the uniformly friendly, courteous and efficient manner in which faculty and staff have anticipated our wants and provided therefor.

4. That we record our gratitude for the outstanding service rendered the Society by Professor H. C. Dillingham and the officers and members of his various committees for the admirable arrangements made for the comfort, convenience and entertainment of the delegates to the convention, and for the orderly and effective dispatch of the business of the convention.

5. That we express particularly to Mrs. F. C. Bolton and the officers and members of her several committees our sincere appreciation of the gracious hospitality and unfailing courtesy extended to the ladies and children of the convention.

6. That we record our thanks for the initiative of the Texas Section of the Society for the Promotion of Engineering Education and the engineering colleges of Texas for their joint efforts to bring the convention to Texas and their coöperation in making it a complete success.

7. That we extend to the railroads leading to East Texas our obligation for their efficient handling of transportation problems; to the Chamber of Commerce of Bryan for its generous contribution to the convention; to the newspapers for the accurate and helpful publicity given to the convention proceedings, particularly to the *Associated Press,* the *Houston Post,* and the *Bryan Eagle* for sending special writers to cover the convention; and to Mr. George Chance for the interesting and thrilling demonstration of cotton dusting from airplanes.

8. That we make special note of the skill and success of Mr. J. C. Hotard of the Subsistence Department of the College in providing excellent and bountiful meals and a sumptuous banquet.

9. That we record our unqualified approval of the institution of barbecue as practiced in Texas and that we recommend Mr. George Long as impresario of the social and culinary achievements connected therewith.

10. That we affirm our conclusion that the forty-sixth annual convention of the Society has been a notable success, and we extend to all of those who have contributed, many of whom are perhaps unknown to us, to the happy event, our admiration for their careful planning and coördinating, their skillful management, and their rare courtesy in accomplishing this fine achievement; and that we make particular mention of the atmosphere of typical Texas informality, friendliness, and good will, that has promoted not only engineering education but friendship and understanding.

11. Finally, that the Society add its praise and admiration for the great State of Texas, our interest in its moving and dramatic history, and our confidence that the lone star of its destiny is rising to full glory.

The Secretary presented the following amendment to the Constitution, which was adopted. This amendment had been approved last year by the Council:

Article II, Membership, second paragraph:

Institutional members shall be of two classes, active and associate. The active institutional members shall be recognized institutions giving baccalaureate or equivalent degrees for curriculums in engineering, *and distinguished national professional engineering societies.* Associate members shall be other educational institutions giving instruction in engineering. Institutional members shall be entitled to representation at all meetings of the Society or its divisions by regularly appointed delegates, one for each institutional member concerned.

(The amendment is that part which appears in italics.)

Announcements were made that the 1939 meeting would be held at The Pennsylvania State College, State College, Pa., June 19–23; and that the 1940 meeting would be held at the University of California, Berkeley, Calif., at a time to be announced later.

The meeting adjourned sine die.

REPORT OF THE SECRETARY, 1937–38

F. L. BISHOP

The Secretary presents herewith a brief summary of the year's activities of the Society.

Membership.—The total membership at this time is 2,933; 2,796 individual members and 137 institutional—109 active and 28 associate.

An astonishing number of new names were added to the rolls during the current year. The Council has elected 377 new members, including 19 to be elected at this meeting. It might be interesting to note that the total membership of the Society in 1905 was 379.

We have lost 163 members—107 by resignation; 33 dropped for non-payment of dues; and 23 by death: H. J. Anderson, G. C. Anthony, R. M. Bird, B. B. Brackett, B. M. Brigman, Arthur Bruckner, J. A. Correll, Herman Diederichs, S. S. Edmands, A. H. Fay, B. W. Fleming, J. W. Hallock, L. M. Hoskins, C. T. Humphreys, C. A. Isaacs, R. B. Nesbitt, E. E. Reynolds, L. R. Sailer, Samuel Slingesland, L. B. Stewart, J. A. Thaler, J. A. L. Waddell, J. C. Wait.

Institutional members. By action of the Council at the 1937 meeting, institutional members were entered into two classes, active and associate. The active membership consists of those institutions which have one or more curricula accredited by the Engineers' Council for Professional Development. This list was prepared by a Committee on Institutional Members, R. A. Seaton Chairman. Through the activities of this Committee 17 institutions have been added to membership. Only one institution objected to this new type of classification, and one institution withdrew from membership after election when notified of associate membership.

At this meeting, an amendment to the Constitution regarding institutional membership, passed by the Council last year, will be acted upon by the Society. This amendment is in Article II, Membership, second paragraph, which reads:

"Institutional members shall be of two classes, active and associate. The active institutional members shall be recognized institutions giving baccalaureate or equivalent degrees for curriculums in engineering, *and distinguished national professional engineering societies.* Associate mem-

bers shall be educational institutions giving instruction in engineering. Institutional members shall be entitled to representation at all meetings of the Society or its divisions by regularly appointed delegates, one for each institutional member concerned."

Meetings.—The annual meeting at Cambridge last year drew the largest number ever registered at any meeting—1,586. This in itself shows a tremendous interest in engineering education but in addition to this there have been 18 sectional meetings with an approximate attendance of 1,500. About 30 branch meetings have also been held. G. W. Case, Chairman of the Committee on Sections and Branches, will present a report on these activities.

One hundred and nineteen prepared papers and discussions appear on the program for this meeting. I mention this because I believe that the preparation of these papers make a decided contribution to engineering education in each of the institutions in which a paper is prepared and certainly the presentation to a group involving critical consideration contributes greatly to the advance of the profession.

Divisions.—The divisions have been extraordinarily active during the year as the program of this meeting indicates. Several of the divisions, notably the Civil Engineering, have had regional conferences during the year, and others are in preparation for next year. These activities create a tremendous amount of local interest and are effective throughout the country. Eighteen conferences are scheduled for this meeting and it is to be noted that several of them occupy two to four half days. Added to this are luncheon and dinner meetings which tend to cement the interest of particular groups.

Progress in Engineering Education.—During the administration of C. C. Williams a committee was formed known as the Progress Committee. Charles F. Scott has been chairman of this group since its inception. Each year a report is published in THE JOURNAL OF ENGINEERING EDUCATION and many comments are received concerning these reports. One dean wrote this year: "I think it is a very valuable and important part of the Society's business thus to record in one brief article a resumé of the year's activities and advances. It seems to me it is worth all the trouble which the committee has put into it and that they have this year achieved an especially excellent result."

Institutional Delegates.—I believe that it is obvious that there are certain functions which should devolve upon institutional delegates as such since they refer not to personal opinion but to the opinion of institutions. With the accrediting of engineering colleges, it seems that this has become a more important function. There will be a meeting of the institutional delegates at this con-

vention at which will be placed before them certain problems dealing primarily with the institutions.

Publications.—The Council last year instructed the Executive Committee to consider the publications of the Society but it is not prepared at this time to make definite recommendations.

The Council has received from H. J. Gilkey a very constructive criticism of the classification of individual members in the year book. The secretary referred the information supplied by Professor Gilkey to the Publication Committee—Messrs. Bishop, Earle and Hammond—with the request that the matter be given careful consideration and that the Committee make recommendations at this meeting to the Council.

Employment.—The secretary's office maintains an employment bureau. It is not feasible to give exact figures as most of this is in the nature of confidential information in regard to possible candidates for positions especially for deans and other administrative officers.

Problems in Engineering Education.—There are a number of problems pertaining to engineering education which come to the secretary's office indicating in some instances a very great interest in the subject. I will mention two, 1, should the engineering course be expanded into a five or a six year program? While this question is old and was apparently settled for us through the investigation of engineering education, as time passes it appears to become a more acute problem and I am inclined to think that students entering engineering colleges now are desirous of having the course expanded into five or six years.

2. The very great increase in labor union activities and especially of architects, chemists and engineers, has led to many questions in regard to the effect of this movement on the engineering graduates and on the engineering schools.

REPORT OF TREASURER, W. O. WILEY

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

Statement of Cash Account, June 20, 1938

Balance on Hand—June 19, 1937:		
Forbes National Bank—Checking Account	$ 3,984.57	
Forbes National Bank—Savings Account	7,327.48	$11,312.05
Receipts:		
Current Dues	$12,826.95	
Back Dues	750.50	
Dues in Advance	256.50	
Sales of Publications	648.77	
Advertising	2,331.72	
Receipts from Sale of Emblems	72.00	
Interest on Savings Account	184.31	
Miscellaneous Income	26.75	$17,097.50
Total		$28,409.55
Disbursements:		
Cost of Publications	$ 7,230.02	
Cost of Proceedings	182.73	
Honorarium for Secretary	1,600.00	
Salaries—Secretary's Office	3,500.00	
Traveling Expense—Secretary's Office	462.08	
Committee Expenses	132.42	
Printing, Postage, Office Supplies, etc.	1,426.48	
Expenses—1937 Meeting	557.71	
Expenses—1938 Meeting	463.87	
Dues—American Council on Education	100.00	
Dues—American Engineering Council	312.50	
Advance for Lamme Award Medal	175.49	$16,143.30
Balance on Hand—June 30, 1938:		
Forbes National Bank—Checking Account	$ 4,754.46	
Forbes National Bank—Savings Account	7,511.79	$12,266.25

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

Income and Expense Statement for the Year Ending June 20, 1938

Expense	
Cost of Journal	$ 6,630.02
Cost of *Proceedings*	182.73
Expenses—1937 Meeting	735.63

Honorarium for Secretary	1,600.00
Salaries—Secretary's Office	3,500.00
Printing, Postage, Office Supplies, etc.	1,426.48
Traveling Expenses—Secretary's Office	462.08
Committee Expenses	132.42
Dues—American Council on Education	100.00
Dues—American Engineering Council	312.50
	$15,081.86
Surplus for the year	2,296.14
	$17,378.00

INCOME

Current Dues	$13,729.95
Back Dues	50.50
Sales of Publications	648.77
Advertising	2,665.72
Sale of Emblems	72.00
Interest on Savings Account	184.31
Miscellaneous Income	26.75
	$17,378.00

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

BALANCE SHEET, JUNE 20, 1938

ASSETS

Cash:		
Current Fund	$ 4,754.46	
Petty Cash Fund	300.00	
Life Membership Fund	816.68	
Benj. G. Lamme Fund	19.43	$ 5,890.57
Savings Account:		
Forbes National Bank—No. 3809		7,511.79
Benj. G. Lamme Trust Fund:		
Securities	$ 4,947.00	
Cash (uninvested)	53.00	5,000.00
Prepaid Expenses—1938 Meeting		463.87
Inventory		1.00
Accounts Receivable:		
Advertising	$ 584.00	
Dues	700.00	
Lamme Medal Fund	175.49	1,459.49
Furniture and Equipment (est.)		100.00
		$20,426.72

LIABILITIES

Life Membership Fund		$ 816.68
Benj. G. Lamme Fund		5,019.43
Prepaid Membership Dues		256.50
Surplus Account:		
Balance at June 19, 1937	$12,037.97	
Surplus for present year	2,296.14	14,334.11
		$20,426.72

NEW MEMBERS

BASORE, CLEBURNE A., Professor of Chemical Engineering, Alabama Polytechnic Institute, Auburn, Ala. J. J. Wilmore, C. R. Hixon.

CLARK, GEORGE W., Assistant Professor of Civil Engineering, Ohio University, Athens, Ohio. W. M. Young, E. H. Gaylord.

COLLINS, BASIL K., Instructor in Industrial Engineering and Shops, Alabama Polytechnic Institute, Auburn, Ala. J. J. Wilmore, A. L. Thomas.

CRAWFORD, BENJAMIN H., Assistant Professor of Textile Engineering, Alabama Polytechnic Institute, Auburn, Ala. E. W. Camp, J. J. Wilmore.

DARLING, WOODROW, Instructor in Electrical Engineering, Alabama Polytechnic Institue, Auburn, Ala. J. J. Wilmore, C. R. Hixon.

FERGUSON, JOSEPH L., Assistant Professor of Engineering, Lynchburg College, Lynchburg, Va. J. B. Jones, J. I. Clower.

FRANCIS, WILLIAM H., Instructor in Machine Design, Alabama Polytechnic Institute, Auburn, Ala. J. J. Wilmore, A. L. Thomas.

GUERDAN, GEORGE A., Instructor in Mechanical Engineering, College of the City of New York, New York City. W. R. Halliday, N. H. Memory.

HANSELMAN, GEORGE R., Assistant Professor of Administrative Engineering, Cornell University, Ithaca, N. Y. W. N. Barnard, J. R. Bangs.

HANSTEIN, HENRY B., instructor in Electrical Engineering, College of the City of New York, New York City. J. A. Lambertine, C. C. Whipple.

HERNDON, LYLE K., Assistant Professor of Chemical Engineering, The Ohio State University, Columbus, Ohio. J. R. Withrow, J. H. Koffelt.

HOLME, JUSTUS M., Instructor in Mechanics, The Pennsylvania State College, State College, Pa. C. E. Bullinger, L. A. Doggett.

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RUSSELL, ALGER D., Associate Professor of Engineering Mechanics, University of Michigan, Ann Arbor, Mich. E. L. Eriksen, W. G. Dow.

TAYLOR, ALEXANDER O., Director, Engineering Extension and Coöperative Education, Alabama Polytechnic Institute, Auburn, Ala. J. J. Wilmore, A. L. Thomas.

WRIGHT, CHILTON A., Professor of Hydraulic and Sanitary Engineering, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. H. S. Rogers, Edward Squire.

ENGLISH NOTES

DEVOTED TO THE INTERESTS OF TEACHERS OF ENGLISH IN ENGINEERING SCHOOLS

J. L. VAUGHAN, *Editor*

A WORD FOR LITERATURE

After years of discussing conscientiously the important and difficult problem of teaching composition—not only its fundamentals, but also its specific applications in writing technical articles, business letters, and reports—is it not time that we teachers of English give more serious attention to the teaching of literature? This question seems pertinent because numerous comments of our graduates—and of some of our faculty members also—indicate that few understand the importance or the function of literature.

Several of these comments may be enough to exemplify the common misunderstanding. In answer to a questionnaire sent out by the late Colonel Robert I. Rees to discover the ability of our graduates to express themselves, a supervisor of some of these graduates, criticizing the college course in English, said in part: "Even the selection of textbooks and theme subjects, and assignments of collateral reading in literature are antagonistic to the technical man's interests and aptitudes. I believe that there is *sufficient good literature in the form of biography or scientific and technical exposition to supplant many of the classics in the collateral reading assignments.*"* (Italics mine.) In a meeting at which the teaching of literature was being discussed, a professor of engineering said he thought the study of literature should be included in the curriculum, but he could not understand why students should be required to read fiction and poetry. "I'd like to know," he asked, "why reading a report on the construction of the Oakland Bridge wouldn't do the student as much good?" Another professor would admit to the curriculum no more than biography, and he advised instructors to gain the students' interest and develop their enthusiasm for their profession by having them concentrate

* Rees, Ribert I., "The Young Engineer and His English," JOURNAL OF ENGINEERING EDUCATION, February, 1933, p. 485.

on reading biographies of engineers. A teacher of English, recounting his chief argument for inducing students to form the habit of reading, said that engineers get tired in their work, as do all professional men, and that literature provides a means of getting away from it and relaxing. Though he did not say it, he implied that literature is valuable chiefly as an occasional way of escaping from reality to a land of make-believe. And graduates have said that engineers ought to read more than they do so that they can mingle more easily with other people who do read.

To those who understand the function of literature, these attitudes must bring a feeling of distress and even hopelessness. The trouble is not chiefly that they are all wrong. There can be no objection, for instance, to motivating the reading habit by getting students to read, at least in the beginning, any good literature in which they are interested; nor can there be any objection to reading biography—even the biography of engineers; nor to reading escape literature occasionally. The trouble is that these attitudes seem to be promoted by only one of two conceptions of the value of literature: that it is a tool for professional use—undoubtedly a weak and dispensable one, but only a tool; or that it is merely a frill—a diversion no more important than attending a dance or baseball game, and therefore unnecessary. It is either a knife and fork or only salad dressing. Most of our colleagues, to be sure, and many of our graduates have a sound understanding of the value of literature, but these sample attitudes may be considered as sufficiently typical of large numbers to make teachers of English wonder whether or not we have been doing our jobs properly. Undoubtedly we have done as well as our fellows in the arts college have with their students who are not majors in language and literature; but one might argue that we ought to do better, since we have a homogeneous group and are not required to give primarily courses that lead to graduate study. If we have not succeeded, probably two basic conceptions of our problem and the need of our students—expressed frequently in annual meetings of the English Section—may be responsible.

One of these, particularly in colleges offering no courses in literature, is that we can supply the students' need for literature merely by coaxing them to read in their leisure time. Obviously, an important aim of all academic work in literature is to help students form the habit of reading; and to achieve this end we have striven conscientiously and well—even ingeniously—by devising many subtle means of calling our students' attention to new and interesting books, by having books on our desks so that the curious may be attracted, by handing out excellent reading lists, by requiring students to read a book or two as a part of their work in

the composition course, by seeking out books in which engineering students might be especially interested, and even by offering them prizes for writing good book reviews. All of this effort is splendid; but in itself it is insufficient.

In the first place, this method does not show students how to read; and that ability is what they particularly need. In some way we must tell them what literature attempts to do; must show them by numerous examples how it achieves its aim; and must thus open their eyes to much that they never saw before. But an instructor using the methods given above can at best show only a few students how to read because he can not possibly find time to reach even a majority; and if he took the time, he would be needlessly wasting both time and energy.

The second reason for the inadequacy of this method is indicated by the first: it is too casual and haphazard, not only in showing students how to read, but also in merely encouraging them. It becomes a kind of "catch-as-catch-can" game, in which, to be honest, we must admit that we catch few except those who want to be caught. These would read without our help—even in spite of it; but the great majority of our students, those who seldom read anything but their textbooks (if they read them) or the popular magazines and the sports page of the newspaper, go by us untouched. Even if we require them to read a book of genuine literature, without telling them how, we seldom instill any desire for further reading. In fact, we probably do them an irreparable injury, because, unless the book be a novel with an exciting plot, they see nothing in it; and they leave us and the college to tell the world that literature is unimportant.

Another basic conception probably responsible for our apparent failure is that a course in literature should consist of material on engineering and scientific subjects. This seems to be derived from the foregoing belief that our chief problem is to cajole students into reading, but implies that once they are interested in reading something, they will of their own volition read genuine literature, and like it. The trouble is that only a few ever make this transition, for the obvious reason that the first type, being like their accustomed reading in textbooks and in technical and scientific magazines, they understand; the other they do not. The first, they readily see is informative and matter-of-fact, dealing objectively with their professional problems, and so they like it; the second, as far as they are aware, gives no information, but is an imaginary concoction of strings of words that produce hot air. It is not practical. Occasionally, for entertainment, they read a novel or a short story; but when they do, they see in it nothing but plot. If this is not exciting, the novel is no good. When they read a

play, they got lost in the peculiarities of technique; when they read a personal essay, they are bewildered by style; and when they read a poem—but they don't! They don't because they don't understand. How to make them understand is something else. But one thing is certain: we cannot do it by even the best instruction in technical and scientific literature.

These remarks, to be sure, are not intended as a criticism of the proper value of this kind of reading, but to point out that by giving a course in it we are not solving the problem of convincing our students that literature is important. Wilfully or not, we are dodging the problem. We place ourselves in much the same position of a salesman who, being sent out to peddle bread, reports that no one is interested in bread, but that he found he could talk people into buying raspberries, and so he sold lots of them. "But," his employer says, "raspberries aren't our line. We haven't a raspberry in the house. We're in the bread business; and by selling all of the raspberries in the world, you don't get rid of our bread. You don't even develop a taste for it. Now, your job is to sell bread; and if people think they don't need bread, you'll have to discover how you can show them that they do need it."

By any method we may fail, but we cannot even begin a solution of the problem unless we are able to have the students in at least one class given over solely and frankly to the teaching of real literature. A number of our colleges have long recognized this need. A few, particularly the independent institutes with only engineering students, have a splendid program of both required and elective courses; but the great majority, though courses may be made available by the general department of English, provide little or no place for literature in the engineering curriculum. This generalization is substantiated by a report * made in 1932 by Professors Creek and McKee, who found that schools in the East and South, including the endowed technical institutes, require an average of between two and a half to three hours of literature; that state universities with land-grant colleges require about an hour and a half; and that state universities without land-grant colleges, exclusive of the East, require less than an hour. In this discussion, of course, the amount of English required by different types of schools is irrelevant. What is important is how generally literature is taught; and in this connection the report makes the significant observation that, even among universities with land-grant colleges, where the average record is fairly good, "eleven . . . in the Middle West and Far West have no required litera-

* Creek, H. L., and McKee, J. H., "English in Colleges of Engineering," *The English Journal*, December, 1932, p. 818.

ture. . . .'' Yet all of these are undergraduate colleges without pre-professional courses in the arts school; and so if literature is not a part of the engineering curriculum, the students get none of it beyond the usual vague smattering given in high school.

Everyone knows that so many technical courses must be included that there is scarcely room in a four-year schedule for others; but it ought to be possible for us to offer at least one two- or three-hour course for a quarter or semester. If necessary, we might even substitute literature for one of our special courses in composition, such as report writing or business correspondence. The content of this course may be of any type as long as it is first-class creative literature. It may be novels, short stories, poetry, or drama—even Shakespearean plays, which many students enjoy; but it should preferably consist of representatives of all types, constituting a course that might be called ''Introduction to Literature.'' The reading, to be sure, ought to be selected with an eye to the interest of engineering students, or, more exactly, the interest of young men. Since we need not prepare our students for graduate study in English, we may choose what we please, observing only the one qualification that each selection be genuine and sincere creative literature.

With students in a course like this, we might be able with a minimum waste of effort to show large numbers of them what the purpose of literature is and why it is necessary to a human being. Moreover, we might be able to persuade them—even those who come to us indifferent and antagonistic—that to live fully, understandingly, and maturely, they must go on through life reading good literature. And our graduates eventually might be saying that literature is important.

W. Otto Birk,
Professor of English,
University of Colorado.

CIVIL ENGINEERING PAGE

F. T. MAVIS, *Chairman*
H. C. BIRD, *Past Chairman*
F. W. STUBBS, JR., *Secretary*
M. W. FURR, *Editor*
H. T. HEALD
PAUL P. RICE
HALE SUTHERLAND

ANNUAL MEETING AT COLLEGE STATION, TEXAS

HAROLD C. BIRD, Past Chairman

Lack of complete information makes a formal report of the Civil Engineering conference at College Station, Texas, impossible at this time. Some of the more important events may be of interest, however.

The Library Committee submitted a progress report of great value, which has been mailed to every civil engineering teacher in the country. If you did not receive your copy write Dean Grinter at Armour Institute of Technology.

Detailed reports of the other committees will be published in a later issue of the JOURNAL. The joint meeting with the Committee on Engineering Research and the Mechanics Division will be reported by Professor Mavis.

One of the highlights of the conference was the Young Instructors' meeting presided over by Professor Conrad. These young men presented excellent papers discussing many problems of the young instructor, which varied from running errands, to the time schedule, and the relation of research to teaching. Visible methods of instruction were taken up and even mathe matical stunts were given attention. These young men deserve a great deal of credit and the older teachers found much to ponder upon from their comments. It is hoped that this will be an annual event of the civil engineering program.

Permission was granted to hold a conference on Hydraulics and Sanitary Engineering next Summer at the University of Iowa. Professor Mavis will keep you informed concerning the details. By the time you read this the Surveying group will have held their second regional conference at the University of Louisville. The advanced registration assures them of a very successful meeting. Dean Grinter reported that the Summer Conference on Structural Practice was well attended.

The Lamme Award was again made to a civil engineering teacher—Dean Robert L. Sackett, who as most of the members know, was a former Professor of Sanitary and Hydraulic Engineering at Purdue.

Professor J. T. L. McNew was responsible for the success of the Civil Engineering Dinner. Mr. E. P. Arneson, director of the Am. Soc. C. E., acted as master of ceremonies and gave us a program which will long be remembered.

The executive committee decided to relieve the divisional chairman of the editorship of the Civil Engineering Bulletin and the C. E. Page in the JOURNAL. The new officers are: F. T. Mavis of the University of Iowa, *Chairman;* F. W. Stubbs, Jr., *Secretary;* M. W. Furr of Kansas State College, *Editor.* The new directors are Professors Furr and Stubb who relieve Professors H. E. Babbitt and Harold C. Bird.

ENGINEERING ECONOMY PAGE

Engineering Economy is the phase of engineering work in which technical plans and operations meet the critical and constructive test of applied economics.

EDMUND D. AYRES, University of Wisconsin, *Editor*

E. C. P. D. ATTITUDE INCONSISTENT AND OCCASIONALLY ADVERSE

The establishment of the Engineers' Council for Professional Development has resulted in the curricula of many if not most engineering colleges of the United States being subject to scrutiny by its accreditization committees and being influenced by these committees. It is therefore a matter of some importance to members of the engineering economy section that apparently the expressed judgment of committees in regard to engineering economy have not been uniform and occasionally adverse. One committee has suggested to one institution that too large a proportion of engineering economy and closely related subjects are required in its curriculum while another committee advised another institution, teaching substantially the same proportion of these courses, to introduce more of them. There also seems to be a tendency for accreditization committees to lump, in their consideraion, courses in engineering economy with courses sometimes termed "non-technical" of which contracts and specifications, engineering law, and technical composition are examples; failing to realize that these may have a different relation to the engineering curriculum and a different basic function to perform.

In light of these conditions and to preserve a rational status for engineering economy, teachers of the subject may properly call upon the Engineers' Council for Professional Development to choose some standards of its own in regard to the place engineering economy should have in engineering curricula and for a better realization of the nature of the subject as a part of engineering training.

Possibly engineering teachers conversant with the field of engineering economy would recommend not less than ten semester credit hours of study in engineering economy and related subjects of economic theory, accounting, industrial problems as they affect engineers, and corporate management and finance; to be given all engineering students in three or four comprehensive courses. Studies in the economy of engineering design and selection should be considered as basic for most engineering training even as mathematics, chemistry, or physics.

The writer has a sincere regard for the work of the Engineers' Council for Professional Development and believes that the matter which has been raised here is just one of the details of its procedure which must be refined.

THOMAS C. ADAMS,
University of Utah.

COLLEGE NOTES

Armour Institute of Technology.—Henry Townley Heald has been elected president of the Institute, succeeding Doctor Willard Eugene Hotchkiss, who resigned last October to devote all his time to civic and economic duties.

His undergraduate work was at Washington State College, where in 1923 he received the degree of Bachelor of Science in Civil Engineering. In 1925 he was awarded the degree of Master of Science in Civil Engineering at the University of Illinois.

He served as junior engineer for the United States Bureau of Reclamation at Pendleton, Oregon, from June of 1923 to September of 1924, his duties involving design, estimating, construction, and inspection work on the McKay dam. From June of 1925 until September of 1927 he was employed as a bridge designer for the Illinois Central Railroad, as a structural engineer for the Chicago Board of Local Improvements, and as superintendent of construction for an apartment building at Pullman, Washington. In September of 1927, Mr. Heald joined the Armour faculty as Assistant Professor of Civil Engineering, giving courses in structural engineering. He held this position for four years, being employed during the summers by the Louisville Bridge and Iron Company and by the Walter Bates Steel Company of Gary, Indiana. For two years, beginning in 1931, he was Associate Professor of Civil Engineering and Assistant Dean of the Institute; in 1933 he was appointed Dean of Freshmen; and in 1934, Professor of Civil Engineering and Dean of the Institute. Dean Heald had large responsibilities in the organization and administration of the day and evening division curricula. He had an important part in developing the cooperative course in mechanical engineering, the Research Foundation, and the graduate program.

Carnegie Institute of Technology.—Three appointments to the faculty of the College of Engineering are: Robert York, Jr., Memphis, Tenn., instructor in chemical engineering. He is a graduate of the University of Tennessee from which he holds the B.S. degree. In 1933 he worked on cottonseed oil research at the University Engineering Experiment Station, and he also taught at the University, studying for his master's degree which he received in 1934. He entered the Massachusetts Institute of Technology in 1934 to do graduate work in chemical engineering, and he received the Sc.D. degree from that institution in June of this year.

Lloyd Thomas Andrew, a graduate of the Colorado School of Mines, instructor in mechanical engineering. Since graduation in 1935 Mr. Andrew has been employed by the Carnegie-Illinois Steel Corporation as experimental engineer in the fuel and steam department of the Duquesne Works.

John Wilson Dougherty, B.S. degree from Oregon State College and the M.S. degree in civil engineering from Carnegie Tech., an instructor in the department of mechanics. He is a native of Portland, Oregon.

Case School of Applied Science.—Kenneth H. Donaldson has been appointed head of the Department of Metallurgical Engineering. For the past few months Professor Donaldson has been acting as temporary head of the department, taking over the duties in February from Professor Herbert M. Boylston who was granted leave of absence due to ill health.

Cornell University.—William Lindsay Malcolm, professor of municipal engineering in Queens University, Kingston, Ontario, Canada, has been appointed director of the School of Civil Engineering in the College of Engineering. Professor Malcolm succeeds Professor Paul H. Underwood, who has been acting director of the School of Civil Engineering since Professor Hollister became dean of the College of Engineering last fall.

Vannevar Bush, Vice-President and Dean of Engineering of the **Massachusetts Institute of Technology** since 1932, has been elected president of the Carnegie Institution of Washington. Dr. Bush is expected to continue his duties as vice president of Technology until next January, when he will take office as head of the great research organization founded by Andrew Carnegie in 1902.

Professor Edward L. Moreland, Head of the Department of Electrical Engineering since 1935, has been chosen Dean of Engineering, succeeding to the position which Dr. Bush has occupied since his election as vice-president.

New York University.—The College of Engineering has established a Graduate Division under its own jurisdiction in which the Master's and Doctor's degrees are offered in the various branches of engineering.

Civil Engineering: H. E. Wessman was appointed Associated Professor of Structural Engineering.

The Nichols Engineering and Research Corporation has established a two year research fellowship in Sanitary Engineering for the study of sludge incineration. The fellowship carries a stipened of $1,000 per year and the recipient spends half time in graduate study and the remainder of the time on research. Similar fellowships have been established by the Freeport Sulphur Company and the Industrial Chemical Sales Division of the West Virginia Pulp

and Paper Company. Graduate work in the field of structural Engineering was inaugurated during the year with such success that an expansion of the program is planned. In addition to the courses offered in Advanced Structural Theory, two new courses will be presented next year, one in Advanced Reinforced Concrete and the other in Advanced Industrial Building Design. In addition, research facilities have been expanded in order to provide for projects of those students interested in working for advanced degrees. A new Model Testing and Photo-Elastic Laboratory featuring a low-cost universal straining frame has been developed in order to supplement the work in Materials Testing.

Chemical Engineering: John R. Huffman has been appointed Assistant Professor of Chemical Engineering.

Aeronautical Engineering: The Daniel Guggenheim School of Aeronautics, first in the field in providing complete university courses in Air Transport Engineering and Operation, has made improvements and additions to its curricula to provide for the more specialized requirements of Air Transport operations. Meteorological courses have been reorganized to conform with modern airline operating practices. After two semesters of fundamental meteorology attention is turned to practical airline applications. The work of the fourth semester is carried out in a model air transport office where problems in combined Meteorology, Dispatching and Airways Traffic Control are studied. Air transport engineering courses cover the fundamentals of operations, communications and maintenance with particular attention paid to the solution of every day problems with which the technically trained man is best fitted to deal. Close contact is maintained with the various air lines so that advantage may be taken of improved methods and new developments as they are introduced. The growing importance of seaplane and flying boat operation is fully realized by the Daniel Guggenheim School of Aeronautics, and of recent years increasing attention has been given to seaplane engineering. The establishment of the Richard Hoyt Memorial Seaplane Fellowship will encourage graduate study and research in this field. The Fellow will be selected from men who have majored in aeronautics in their undergraduate work.

The Guggenheim School of Aeronautics announces the appointment of James M. Coburn, assistant chief navigation engineer for Transcontinental & Western Air, Inc., to its faculty. Mr. Coburn has been connected with the airways and navigation department of TWA for two years at its Kansas City headquarters. His experience in aviation dates back to the World War days when he joined the signal corps of the United States Army and was sent overseas for training with the British.

Meteorological Division: New appointment—Assistant Professor Athelstan F. Spilhaus.

In the Graduate Division, a new course, Dynamic Meteorology, is being given. This comprises a theoretical treatment of the physical processes in the atmosphere.

The College of Engineering has received a grant from the Engineering Foundation for the furthering of the study of Wind Phenomena in the Lowest Layers of the Atmosphere by the means of a photographic method of wind sounding designed by Athelstan F. Spilhaus. This study is a unit of a research program in Meteorology which is contemplated.

Mechanical Engineering: Introduction of the Air Conditioning Option and laboratory equipment, specially built for this course.

Engineering Mechanics: The new department of Engineering Mechanics includes all work in theoretical mechanics, mechanics of materials, and fluid mechanics, including graduate work in these subjects. Assistant Dean William R. Bryans is head of this department.

Industrial Engineering: During the current academic year there have been four additions to the teaching staff: L. P. Alford, Professor of Administrative Engineering and Chairman of the Department of Industrial Engineering; A. I. Peterson, Assistant Professor of Engineering Economics; George E. Hagemann, instructor; Joseph A. Piacitelli, Lecturer. One change has been made in the work of the department, by initiating graduate work.

Department of Mathematics: James J. Stoker, Jr., was appointed Assistant Professor of Mathematics.

ENGINEERING STUDENTS

Inferences Drawn from a Report of the Carnegie Foundation for the Advancement of Teaching

1938

By R. L. SACKETT

Dean Emeritus, Pennsylvania State College

"The Student and His Knowledge" is the title of a summary of the studies made in Pennsylvania of high school seniors, college sophomores and seniors in 1928, 1932 and 1934. While the report deals with the measurements of knowledge retained at these various levels by college students in various curricula, engineering sophomores to the number of 543 in seven institutions are a part of the 5,747 college sophomores tested in 1930, and 3,720 college seniors given identical tests in 1932. "There were 1,222 questions assembled under the title of General Culture." The same questions were given 1,503 high school seniors in 1933 and 1934.

No summary can do justice to the report but there are certain observations which may be ventured:

1. Much to the credit of the sophomore engineers, their median score was higher than the median of all sophomores in this cultural test. This fact should be quoted in rebuttal when the engineer is indicted for lack of liberal knowledge.

2. The spread in total scores of college sophomores and seniors is disturbingly great and engineers seem to be no exception.

3. The top 40 per cent of high school seniors had as much general knowledge as the bottom 40 per cent of college sophomores.

4. There were college seniors who knew little more than low grade high school seniors. Over 1,000 college seniors out of 3,720 did less well in this test than the average college sophomore—in other words, had forgotten more than they had learned.

The report says, "Two features that are conspicuous in the Pennsylvania findings are, first, the fact of student *variability* in intellectual resources and, second, the fact that these resources are measurable."

This emphasizes again, as it has been frequently emphasized, that many are admitted that do not have the knowledge, aptitudes, interest or perseverance to *improve* under our present system.

The report also states and gives supporting evidence that the

relative degree of achievement at any one of the levels tested can be measured.

The most severe indictment is of institutions which apparently ignored the case histories of a group of 150 selected high school pupils conducted through a three year curriculum with cumulative records available. A list of 70 students was sent to 42 colleges "including most of the well-known institutions east of the Mississippi River." "Evidently, the 23 institutions on which the data made no impression feel at present little, if any, need for such information about an entering student." "If every student must be thrust into one of three or four standard hoppers, why be concerned with information showing that he really belongs in none of them."

There follows further comment concerning the value of such cumulative records. Such statements as, "By its use most of the misfits between school and college that now swell the tables of freshman and sophomore mortality could be avoided" should not be ignored or forgotten. The report gives little support to those who argue that the trial and error method of admission gives as much return for the investment of time, money and human effort as a more selective process would. Chance is the last resort where science fails.

Another challenging sentence is picked from its setting because it seems to need no argument to those who have given much thought to effective education, technical or otherwise. "The students' personal equipment—tastes, skills, interests, or inaptitude and aversions—should likewise be put on the record in such a manner as to furnish both the institution and *himself* (italics mine) with a definite basis for observing growth and change."

Long concern with the individual engineering student leads me to emphasize the importance of giving continuous consideration throughout his college career to his personal development and he should know his strength and his weakness.

The former he usually knows; of the latter he is more often ignorant. And more the pity, because his teachers, if they are what they should be, are his most effective counselors.

The report arraigns mass education and pleads for individual or self-education. For those who are concerned with guidance and admission programs, it is worth study in order that one's conscience may be clear or steps taken to provide incentives to the student so that *he* may go further if he has the ability, ambition and objectives. The unfit often rob the capable by impeding their progress. More careful selection, more personal guidance and individual programs for some subjects which excite them would help in meeting the problems which every department, school and college meets.

PREPARATION OF COLLEGE TEACHERS*

By HOMER L. DODGE

Director of the School of Engineering Physics and Dean of the Graduate School, University of Oklahoma

I shall begin with a quotation from Professor H. S. Jennings, of The Johns Hopkins University, which deals with one of the fundamental causes of the difficulties in which mankind finds itself at the present time, and so is of interest in that connection, but which I am quoting because of its bearing on some of our current educational problems. He says:

"Mankind is a single great organism temporarily divided into pieces —the individuals. . . . The life of the great organism is carried on through the individuals that form the strands of the network. . . . The single individual finds himself intensely interested in providing for the needs of that part of the net which he constitutes. He is almost equally interested in the other parts that are in intimate relations with him: the members of his own family, of his own community. A union of feeling, a sympathetic imagination, binds these so that they act in harmony. . . .

"But this sympathetic imagination does not originally carry to great distances nor cover great numbers nor unfamiliar conditions. . . . The pleasures and pains, needs and satisfactions of men outside the individual's restricted circle are not present to his mind as realities. . . . The individual combats the needs, the welfare, of outsiders—not from ill-will, but from lack of imagination.

"Under modern conditions this failure of the sympathetic imagination to reach distant men is the largest cause of trouble. . . . Men that in the circle reached by their sympathetic imaginations are gentle and kindly become through this failure of the imagination unjust, merciless, ferocious. Its results are seen in the hatreds of classes and sections, in the oppression of the weak by the strong, in the practices summed up in the maxim that business is business, in graft and racketeering; and on a grand scale in warfare. With the development of modern means of transportation and attack, it threatens entire nations with destruction and raises questions as to the possible extinction of mankind."[1]

Just as individuals and nations cannot with impunity ignore other individuals and nations that make up the great network of which they are but strands or sections, so no part of our educa-

* Presented at the 46th Annual Meeting, S. P. E. E., A. & M. College of Texas, June 27–30, 1938.

[1] Jennings, H. S., "Biology and Social Reform," *Journal of Social Philosophy*, 2: 155–166 (No. 2, January, 1937).

tional system can with impunity ignore any other part. The college of engineering is concerned *vertically* with our system of education from the elementary school to the graduate school and *horizontally* with the work of other colleges at its own level, especially those of liberal arts, business, and education. So important is subject matter content in engineering education and so effectively motivated have been the majority of engineering students that there has been a tendency for engineering education to exist as a somewhat distinct strand of the educational system. With this has gone a tremendous sense of responsibility for the effectiveness of this strand and I have often, among other groups, cited the work of the Society for the Promotion of Engineering Education as an example of how much can be accomplished when a subject matter group recognizes its dual obligation to subject matter and to teaching.

If one reads the *Proceedings* of the Society, one finds that the emphasis upon the teaching function as something implying much more than a mere knowledge of subject matter is greater than is usually found among corresponding groups in other fields. One does not, however, either in the literature of engineering education or in the curricula of engineering colleges find evidence of any great effort being made (other than through thorough grounding in subject matter) toward the preparation for teaching of that considerable number of engineering students who find their way into the teaching profession.

I have recently been making a study of the preparation of college teachers and I have been struck with the fact that this subject has usually been considered from the liberal arts standpoint alone. Little is ever said about such fields as engineering, business, law, music, medicine, etc. It is somewhat surprising that the liberal arts group has been as negligent of its obligations in the teaching field as any of the others. Perhaps it will be of interest to consider the present situation with respect to the general problem of the preparation of college teachers and then see what inferences can be drawn applying to engineering education.

There was little discussion of the preparation of college teachers until 1927, when a committee of the North Central Association submitted a report on the professional training of college teachers, prepared by the late Dean Haggerty.[2] Two years later, the Association of American Colleges formally adopted the report of the Commission on Enlistment and Training of College Teachers, presented by President Wilkins.[3] This report recognized that

[2] Haggerty, M. E., "The Professional Training of College Teachers," *The North Central Association Quarterly*, 2: 108–123 (No. 1, June, 1927).

[3] Wilkins, E. H., "Report of the Commission on Enlistment and Training of College Teachers," *Association of American Colleges Bulletin*, 15: 40–45 (March, 1929).

the major elements in the graduate training of college teachers should be mastery of subject matter and some experience in research, but asked that the research requirement should be relaxed. It also asked that the candidate should be required to show a broad range of intellectual interest and experience, should be trained in methods of teaching his subject, should observe the teaching of successful teachers, and should himself teach under supervision. It was recommended that the graduate school should offer a course in the American college, dealing with progressive instructional and curricular movements and with departmental and general administrative service.

Copies of the report and requests for comments were sent to the deans of the graduate schools of the members of the Association of American Universities. The replies [4] were published in the Bulletin of the Association of American Colleges and indicated unwillingness to relax the research requirements, opposition to courses in education, and satisfaction with the work of students as graduate assistants as a preparation for teaching. Only a few favored special courses for teachers.

Nevertheless, the Association of American Universities was inspired to appoint a committee on the training of graduate students for college teaching which made a report [5] in the fall of 1930. This was composed largely of statements prepared by the deans of the various graduate schools. These statements were, on the whole, more conservative than those which had been made directly to the Association of American Colleges.

Two years later, in 1932, the Association of American Colleges heard a second report[6] from their committee, which consisted of a carefully prepared statement of the chairman, Dean Payne, of Indiana University.

Dean Payne reiterated his belief that good teaching and research cannot be separated and that the subject matter requirement cannot be materially reduced. He was willing to sanction a course on the problems of the college but he expressed little enthusiasm regarding any contribution that the school of education could make.

This is the last word upon the subject from the Association of American Universities and the situation has not changed ma-

[4] *Association of American Colleges Bulletin*, 15: 346–379 (November, 1929).

[5] "Report of Committee on Training of Graduate Students for College Teaching," *Proceedings of the Association of American Universities*, 32: 33–42 (1930).

[6] "Report of the Special Committee on the Training of Graduate Students for College Teaching," *Proceedings of the Association of American Universities*, 34: 87–101; "Discussion," 101–113 (1932).

terially since 1932. We have the consumer and the producer facing each other in complete disagreement with regard to the proper specifications for the product to be exchanged. The college thinks that it wants one kind of teacher and asks for it but the graduate school thinks that the college should have another kind of a teacher and that is what is furnished. Clearly this is a condition which cannot continue.

It happens that there are available two recent studies which have a bearing on the problem. In 1935, Dr. Anna Y. Reed of New York University, in "The Effective and the Ineffective College Teacher,"[7] presented the carefully considered opinions of nearly three hundred presidents and deans of arts colleges concerning the fifteen major qualifications of college teachers. These qualifications were ranked according to desirability and the difficulty with which they are secured. If the two rankings are combined, the leading qualifications are: (1) inspirational power, (2) general scholarship, (3) originality in thought and method, (4) general culture, and (5) potential teaching efficiency. Specialized knowledge and research ability come far down in the list.

Recently Dr. H. B. Byram[8] studied the problems which college teachers meet and find difficult. He prepared a list of forty problems and submitted them to a large number of young college teachers of academic subjects. Four hundred and eighty-five supplied information regarding the problems they had met and over fifty per cent of these had met thirty-two of the forty. The first seven problems with which forty per cent had especial difficulty are:

1. Developing in students the ability to do straight thinking.
2. Adapting instruction to the differences found in the personnel of the class.
3. Aiding students in establishing efficient study habits.
4. Diagnosing student difficulties in studying.
5. Developing or setting up standards of student scholarship and achievement.
6. Determining the fundamental educational principles which are to give direction to teaching.
7. Grading or marking students.

It seems to me that these topics are susceptible of helpful treatment in a course for prospective teachers, although such a course,

[7] Reed, Anna Y., "The Effective and the Ineffective College Teacher," American Book Company, New York, 1935, pp. 174–175.

[8] Byram, H. B., *Some Problems in the Provision of Professional Education for College Teachers*, Contribution No. 576, Bureau of Publications, Teachers College, Columbia University, New York, 1933.

to be of value, must be taught by a person who could win the respect of the better students.

It is not to be concluded that I have any faith that the mere taking of courses in education is going to solve the problem. Such courses have been offered and have failed to function. Professors of education will be able to make their contribution to the preparation of college teachers only as those responsible for subject matter training see fit to make use of their contribution. Any forced taking of courses in education through state requirements will do more harm than good and this is recognized by leading educationists today.

Recently it has been my privilege to have the comments of a large number of subject matter professors with regard to the value of special training in education and the advantages of coöperation between subject matter departments and schools of education. At the present time, these subject matter men are, as a rule, concerned with the preparation of secondary school teachers, but their experience should be of significance with respect to college teaching.

In my letter of inquiry I explained that I was interested in "the extent to which, and the way in which, subject matter departments and the school of education might profitably coöperate in the preparation of college teachers." I asked particularly about the desirability of subject matter departments having on their staffs persons deeply interested in the preparation of teachers, the extent to which such persons would be expected to be trained in education, and whether schools of education should develop subject matter staffs of their own. To such an audience as this it may seem strange that the last question has to be raised at all, but, in the absence of interest on the part of the subject matter departments, there has been a tendency for schools of education to take over the subject matter training of teachers and enter the subject matter field.

There runs through all the replies the idea that the preparation of both secondary school teachers and college teachers is primarily the duty of the subject matter departments and that it is a duty that has been neglected. The opinion of many is represented by Professor Reynolds, Department of English of the University of Colorado, who says that "the neglect by the college departments of the training of teachers in their subjects has plunged us into our present morass."

All but one or two of the fifty or sixty persons expressing themselves on the point felt that subject matter departments should attempt to have on their staffs persons deeply interested in the preparation of teachers. They also said that courses in the meth-

ods of teaching should be taught in the subject matter department.

Professor Coleman, Department of Romance Languages of the University of Chicago, believes that "it is preferable that the special methods courses and the apprentice teaching be directed by the members of the departments concerned." But it must be assumed, he says, "that the persons concerned are genuinely interested in the task, are well informed about the state of affairs in their field of teaching, and do not consider the special methods courses as an additional opportunity to give students more subject matter."

Professor Selvidge, Department of Industrial Education of the University of Missouri, writes:

> "In my judgment, the most effective method of securing good teachers is to have them trained in the subject matter by men who have the subject matter material well organized for teaching purposes, and who use good methods of procedure in its presentation. This is to be followed, or accompanied by, a study of the principles involved in the selection and organization of instructional material, the methods of presentation, the economical procedure in different types of learning, together with some of the simple devices of assignment, questioning, and testing. A man so trained will make a better teacher than the individual who has completed an extensive college course in subject matter, indifferently taught, or taught without being organized from the standpoint of learning difficulties, or the one who has given much time to 'education courses' and relatively little to subject matter."

The letters laid great emphasis on the need for sincere interest in teaching. For example, Professor Gustavson, Chairman of the Department of Chemistry of the University of Colorado, would not allow anyone to teach in college "who is not interested in teaching as a technique." In all cases it is assumed that subject matter is a *sine qua non*. Professor Selvidge stated it thus, "It is obvious that no one can teach subject matter unless he knows it. It is equally obvious that the mere knowledge of subject matter does not enable one to teach it."

Most of the subject matter professors were sympathetic with training in education. Some, like Professor Meylan, Department of French of the University of California, and Professor Grant, Department of English of the University of New Hampshire, believe that actual experience in the type of teaching to be dealt with in a methods course is necessary but doubt whether it calls for a thorough training in education. Professor Ullman, Department of Latin of the University of Chicago, believes that "the chief qualification is a sympathetic interest in the question of teacher training, rather than any specific preparation."

Many, like Professor Reynolds, Department of English of the University of Colorado, think that training in education is necessary. To quote him:

"Teacher training in a subject should be in the hands of the subject matter department. But the teacher of it should also be well grounded in educational methods, terms, and philosophy. . . . I admit readily enough that Education has an increasingly valuable fund of information to impart to all teachers."

Professor D'Arms, Department of Classics of the same institution, says that "professional educationists have much to give." Professor Bawden, Division of Natural Sciences of the College of the Pacific, says that he has "taken a number of education courses recently and feels that departments of education have a great deal to offer subject matter departments." Professor Churchman, Department of Romance Languages of Clark University, says that his "own teaching improves steadily as a result of increasing knowledge of new techniques and principles."

Professor Thorpe, Department of English of the University of Michigan, suggests that each of the larger subject matter departments should have "at least two men who are members of both faculties (literary and education), one with a special interest in the secondary field and one in the college field." Such liaison men were suggested many times in these letters. To quote Professor Thorpe further:

"These men should be clearly aware of contemporary thought and movements in education, should be in close touch with both faculties concerned, should be mature, experienced, and influential both in education and their chosen subject matter. Such liaison men should feel it a part of their obligation to help bring about a better understanding between the literary and education faculties, and should make it their business to help find ways to reconcile the different points of view of the two groups. These men should be mediators between the department concerned and the school of education in such matters as planning subject matter curriculums for teachers, setting qualifying examinations, etc."

I hope that I have not given the impression that these men whom I have been quoting have any idea of betraying subject matter into the hands of the educationists. One of the questions that I asked was whether schools of education should be encouraged (or permitted) to develop subject matter staffs of their own. More than fifty expressed distinct opposition. Only two approved and one of these seems to have misunderstood the question.

If, on the other hand, you have gained the idea that practically every subject matter professor with whom I have been in correspondence believes that the department should interest itself ac-

tively in teaching problems and the preparation of teachers, it is a correct one. If you feel that the majority of them are sympathetic toward education and willing to play the game with educationists, I have interpreted their points of view correctly. But I hope I have not given the impression that they are willing to turn any appreciable amount of responsibility to the educationists or call upon them to contribute to any large extent to the preparation of teachers.

Several subject matter men join in the sentiments expressed by one in the words, "I personally shall *resist* the professional instruction of college teachers in any such manner as secondary school teachers have been trained." Another refers to the "mummery developed in connection with education courses—a large percentage of which deal with the mechanism of school administration, rather than with teaching, to such an extent that we have become so interested in the machine that we have almost forgotten its purpose."

It is difficult to generalize from such a large body of opinion but I believe that it is fair to say that the average subject matter man who recognizes that teacher preparation involves something more than mere mastery of subject matter is searching for some way to overcome the inertia represented by the traditional subject matter attitude without in so doing throwing the solution of the problem into the hands of the educationists. He is reaching out for some reasonable cooperation so that the subject matter departments may justify their maintaining the chief responsibility for teacher preparation while providing a proper place for education.

This growing tendency toward cooperation has been helped by the change of attitude of men in education. Most leaders in education to-day are in full agreement with the view that training in subject matter is not a part of their function and that their place is to coöperate with subject matter departments rather than to dictate.

There are those who will take exception to this statement. For example, in the April, 1936, number of the JOURNAL OF ENGINEERING EDUCATION, Franklin O. Rose, at that time Instructor in Engineering and Mathematics, Modesto Junior College, California, but now at the University of Southern California, in condemning "the emphasis placed by educators upon the importance of teaching technique at the expense of subject matter" says, "If I had ever heard a member of an education department admit the importance of knowledge of subject matter, or of one who had ever suggested its importance to his students, I would not feel so strongly on this question."[9] Mr. Rose's article clearly indicates that he has had

[9] Rose, Franklin O., "The Influence of the Education Departments on Engineering Education," THE JOURNAL OF ENGINEERING EDUCATION, 26: 643–646 (No. 8, April, 1936).

unfortunate experiences in his own exposure to education and in his observations of its influence on the junior college situation in California.

But do you remember that in the June, 1936, number of the JOURNAL, R. L. Sweigert, Associate Professor of Mechanical Engineering, Georgia School of Technology, answered Mr. Rose? Among other things he said:

"Unquestionably there are plenty of faults to be found in colleges of education. There are also plenty of faults to be found in colleges of engineering. . . . I have had experiences in both. . . . There are things in the college of engineering from which engineering educators can profit. . . . For the engineering educator, particularly the younger ones, educational philosophy, educational psychology, educational statistics, tests and measurements, student personnel problems and procedures, and perhaps a little study in fundamental curriculum construction and supervision would be of benefit. . . .

"There are still too many engaged in teaching who underrate the importance of the student. . . . The engineering teacher must, first of all, thoroughly know his subject. But that is not sufficient. He should be thoroughly familiar with the student and all that concerns him in the educational process. A first-class job of educating prospective engineers cannot be done unless the subject matter and the student are joined together through a process of stimulated thinking. . . . Let us, as engineering educators, have open minds and use those things from the education colleges that will help us to do a better job in engineering education." [10]

Professor D. C. Jackson has said, "An engineering teacher belongs to engineering first and then to education." [11] We can agree to that, but I would remind you that Dean Hammond brought out in his presidential address last year how inadequately prepared our beginning instructors are and how little help they receive from experienced colleagues who could shorten their period of floundering apprenticeship by friendly assistance.[12]

I am offering to-day no panacea—no simple formula. The educationist has just as much right to resent the request that a liberal education in his field be delivered in pill form as did the engineer, cited by Mr. Rose, when he was asked by the doctor of education to outline the subject of surveying in a couple of hours.

In this reference to an "educational pill" some of you will recognize that I am thinking of the discussion of Dean Holmes' paper [13]

[10] Sweigert, R. L., "Education and Engineering," THE JOURNAL OF ENGINEERING EDUCATION, 26: 785–787 (No. 10, June, 1936).

[11] Jackson, Dugald C., "Objectives of Engineering Education," THE JOURNAL OF ENGINEERING EDUCATION, 26: 81 (No. 1, September, 1935).

[12] Hammond, H. P., "The Engineering Teacher," THE JOURNAL OF ENGINEERING EDUCATION, 28: 9–18 (No. 1, September, 1937).

[13] Holmes, H. W., "Practical Outcomes of the Study of Education Since 1900," THE JOURNAL OF ENGINEERING EDUCATION, 28: 81–95 (No. 2, October, 1937).

at the Cambridge meeting when he denied the existence of any short-cut and yet was generous enough to indicate that a great deal could be gotten from Professor Spaulding's lectures printed in the JOURNAL in 1930–31.[14]

All that I am suggesting is that, since the leading men in the field of education are now freely admitting that the preparation of teachers for the college and professional school is primarily the responsibility of subject matter professors, it is incumbent upon us subject matter people to accept the challenge.

I know of no group better able to cope with this problem than the members of this society. No other subject matter group has taken its teaching function so seriously and given so much attention to problems of teaching. The S. P. E. E. is certainly well prepared to accept the challenge presented through changing social conditions and a better appreciation of the purposes of higher education. If we accept this challenge, I feel sure that we will need the coöperation of our colleagues in the field of education. As we work with them, they will come to understand our point of view better and will be more able through their courses and in other ways to render the assistance that is needed.

For some years there has been a growing feeling that college and university work is inadequately meeting the demands that society is placing, and has a right to place, upon it. It is fitting that teachers of engineering should raise the question as to whether or not there are aspects of the preparation of the engineer and the engineering teacher that are being neglected. In our emphasis upon subject matter as a means of preparing students to earn a living, we may be neglecting what is perhaps the more important phase of education—preparing students to live a life. The purposes of college and professional education, the purposes of the department, and the purposes to be served by the individual course are beginning to be questioned by subject matter professors as well as by professors of the philosophy of education.

Around the tables at the Christmas meeting of the American Association for the Advancement of Science at Indianapolis, I heard more discussion regarding the need for an evaluation of the place of science in the program of general education than of any other topic. It was also discussed formally in the Council meetings and I find in the introductory paragraph of the official report of the Permanent Secretary, these words:

"It is quite possible that . . . the meeting . . . in Indianapolis . . . will be remembered as the beginning of a new era in the association. . . .

[14] Spaulding, Francis T., "Getting Students to Learn," THE JOURNAL OF ENGINEERING EDUCATION, 21: 220–236; "Getting Students to Stay Taught," 21: 287–303; "Can the Teacher Justify His Job?" 21: 384–403 (Nos. 3–5, November, December, 1930; January, 1931).

Its most notable characteristics were the fine spirit of coöperation among scientists in different fields and the increasing sense of responsibility of scientists to society. As an editorial in the *Washington Post* expressed it, 'the current movement might be described as an effort to shift from science for science's sake to science for the sake of humanity.'" [15]

A similar attitude found expression among social scientists a decade ago. In "A Charter for the Social Sciences in the Schools," Dr. Charles A. Beard states that included among the factors that condition instruction in social studies in the schools are not only "the spirit and letter of scholarship" but also the "realities and ideas of the society in which it is carried on" and "the nature and limitations of the teaching and learning process at the various grade levels across which it is distributed." [16] As Dr. Krey says in his introduction to this book:

"There is need of wise readjustment in our thinking and our educational program to a world that has become urbanized, mechanized, and interlocked in its social, economic, political, and cultural interest." [17]

In the languages and literatures there has also been a change of emphasis. The first courses in modern literature were developed from a philological and historical tradition. They prepared the student to do what his teacher had done—to become a historian of literature rather than to understand it. The new movement is toward the critical approach to literature, discovering the intellectual, social, and æsthetic values for anyone and not merely for the one who is to become a philologist or historian. In the work in composition there is a definite trend toward encouraging the students to write about current political and social problems and his actual experiences.

It is this changing spirit on the part of subject matter professors that is opening the way to a solution of the pressing problems of the improvement of teaching and of the preparation of college teachers. We must look for something more fundamental than the taking of a few courses in education or a mere knowledge of subject matter. We must look toward an acceptance of the improvement of college teaching as a common problem of the subject matter specialist and the sincere student of education. If we do that we will find that together we can solve these problems.

[15] Moulton, F. R., "The Third Indianapolis Meeting of the American Association for the Advancement of Science and its Associated Societies," *Science*, 87: 95 (No. 2249, February 4, 1938).

[16] Beard, Charles A., "A Charter for the Social Sciences," Charles Scribner's Sons, New York, 1932, p. 2.

[17] *Op. cit.*, p. vi.

A PROGRAM FOR UNIFICATION AND CORRELATION IN ENGINEERING EDUCATION *

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Present Status

The problem of engineering education is constantly becoming a more complex and difficult one, and educators are beginning to realize that we are moving toward an impossible situation in connection with our curricula. The complications which have arisen are the natural result of growth and development in all branches of engineering, in addition to a realization of the increasing scope, responsibility, and importance of the profession. In the first place, the rapid technological development which we have experienced, and which is now in progress, makes it imperative that our students receive a broader and more basic understanding of scientific principles. Secondly, it is becoming recognized that adequate preparation for the profession should include additional emphasis upon the economic and financial aspects of engineering. The engineer should know more about business principles and methods, and realize the importance of financial considerations in an engineering undertaking. Furthermore, the engineer should have a thorough knowledge of human nature since his life work will require close association with his fellow men. His college education should develop in him an interest in government and current problems so that he can become a useful and influential part of the world about him. This means that more attention must be given to practical psychology, sociology, and government. The widening scope of the profession has been appropriately emphasized in the Fifth Annual Report of the Engineers' Council for Professional Development.

Once we frankly admit this situation we find ourselves confronted with the problem of adjusting our curricula and teaching methods to meet it. How much we can expect to accomplish in a course of four years becomes an open question but there is no doubt regarding the desirability of improving the quality of what is undertaken within the allotted time whether it be four years or

* Presented at the 46th Annual Meeting, S. P. E. E., A. & M. College of Texas, June 27–30, 1938.

more. Fortunately, problems of analysis are common in the engineering profession, and we can credit much of our progress in the past to the conscientious attention which engineering teachers have given to analyzing their college curricula. Great care has been taken to insure that all necessary courses be included so that the student shall receive an adequate introduction to the many and varied subjects required for a profession which has an ever-widening field. However, it would seem that we have now reached a time when we must concentrate our attention less on the separate subjects and more on the synthesis of the component parts of the complete undertaking.

Educational Requirements

If our purpose to-day is to produce engineers who will prove to be not only leaders in their professional field but outstanding members of society, we must steer our course directly toward this end. The distinguishing characteristics which in the past have been the pride of our engineering colleges will not in themselves be sufficient. In addition to the development of proficiency in engineering techniques, respect for truth and accuracy, and the acquisition of scientific knowledge, there must be a new vision and a new spirit. The emphasis must be put upon developing and disciplining the mind of the student so that his outlook will be broader and his aspirations higher. The situation to-day calls for a renewed effort to produce a comprehensive understanding which will enable him to think accurately, and to analyze correctly new circumstances and problems, not only in engineering but in all phases of life.

The Unification Principle

From the days of Plato to Mark Hopkins the most effective education was accomplished through the efforts of single great teachers. These men possessed broad knowledge and understanding which they were able to impart to their pupils through intimate contact. They taught many subjects and philosopized regarding them, continually pointing out the unity and relationships which everywhere exist. Various subjects were mastered individually, but the great teacher brought clearer vision to his students by bringing the separate parts to a common denominator as it were, so that deep understanding and true education resulted. Our problem to-day is to find a way to produce, through the combined effort of many teachers in various subjects, an understanding of the unity in all the laws of nature, which was made evident in such a splendid manner by the individual efforts of the great teachers of the past.

In the development of our engineering curricula much thought and effort has been expended in an endeavor to include all the fundamental subject matter required for the profession. The great need at the present time is to bring to the student an understanding of the mutual relationship of the various parts of his education so that they will form in his mind a united whole. For good practical reasons the courses of any curriculum are given by different departments. This often causes the student to look upon each course as something which can be completed and forgotten before a new and different subject is undertaken. Courses thus become separate and distinct elements in his mind—a required number of which are considered an education. George A. Orrok * refers to "subject complexes" and speaks of the individual courses as being taught in "watertight compartments." In order to rectify this situation we must break down the "subject complexes" and open up the "watertight compartments."

The task before us might be compared to the painting of a picture wherein the subjects of the curriculum become the colors, and the final impression left upon the student's mind, the completed painting. If instead of a single artist we have several, each using a separate color and giving little or no attention to the work being done by the others, the result is a canvas blocked off into different colors. In our case the blocks are mathematics, physics, chemistry, mechanics, economics, history, and so forth. Conceding that under existing conditions we can accomplish our purpose only through group action, then it becomes imperative that the group produce a picture wherein the individual colors appear as mutually dependent and interrelated, essential parts of a coherent, intelligible whole. Such a picture will have unity, form, and beauty. The undertaking will require skill, patience, and enthusiastic coöperative action, qualities which exist in good measure among teachers of engineering. What is essential is a full appreciation of the necessity for such an undertaking and a deep seated conviction that the end justifies the effort.

Unification Applied to the Curriculum

The subjects of the modern engineering curriculum may be listed in two main categories. One group would include all the science and engineering courses while the other would embrace those of a more general nature, *i.e.*, all non-science and non-technical subjects. Robert E. Doherty † has termed these classifica-

* George A. Orrok, "Aims and Objectives of an Engineering Education." *Mechanical Engineering*, August, 1937.

† Robert E. Doherty, "Readjustment of Policy and Program in Engineering Education." *Proc. of the Soc. for the Promotion of Eng'g Education*, Vol. XLII, 1934.

tions the "Science Stem" and the "Social and Economic Stem." A further analysis breaks down each group into a number of subjects for each term. The plan of unification herein advocated calls for a strong bond and inter-relationship between all the courses in each of the separate groups, and a somewhat looser correlation between the two main groups. The interlacing of the courses of a single group should be so strong as to weave them together into one closely knitted whole. All barriers should be broken down and the student should recognize before him a single, unified program. This program should commence with his first day in college and develop logically and consistently from day to day and from term to term right through to graduation.

Such a plan requires a new philosophy and a new idealism in engineering teaching. It requires a degree of coöperation between members of different departments similar to that which now exists within the separate departments themselves. It also requires, especially in the early stages of the course, teachers who are gifted with broad understanding and sympathy; teachers no longer willing to be simply specialists in one subject, but each doing his part in the group effort.

This plan of unification has aspects in common with modern trends in education in general. In the first place by commencing upon a unified course immediately after entrance to college we would be able to capitalize upon the enthusiasm which the beginning student has for his chosen field of study. He would start immediately upon work which is essentially part of the engineering program and which he would recognize as such. Under the present plan a student often finds it difficult to maintain interest in the preliminary courses, which are likely to be viewed as something which must be passed and "gotten out of the way" before what he terms "real engineering work" can be commenced about two years later. A somewhat parallel situation has existed and been rectified in other fields of learning. For instance, the older indirect method of teaching music required that a pupil learn time, notes, and scales through practising five-finger exercises. To-day he learns to play melodies from the outset and acquires the necessary skills and techniques as part of his complete development. Another common illustration is the modern method of teaching art. Children now begin by drawing pictures instead of practising over a dull period with vertical and horizontal lines. And so in engineering education the student would start at the beginning of his course to use the methods of the engineer. He should immediately commence the process of learning to think constructively and to reason soundly and accurately. As each new principle is met he should study its many implications, investigating the relations involved.

Not only would this plan result in increased interest on the part of the student but aptitudes would be discovered at an earlier date. Students would have the opportunity of determining their natural capacity for the work of the profession without waiting until their junior year. Those not possessing the necessary qualifications would be enabled to effect a change in their plans without serious waste of time, and those adapted to the engineering profession could go forward with renewed confidence.

Physical Sciences and Mathematics

The engineer is concerned with the utilization of the forces of nature. Therefore, fundamental physical laws are the very backbone of engineering and the subject of physics forms the foundation for the engineering courses of the curriculum, which are largely specialized courses in physics having specific practical value. It thus becomes essential that the engineering student form proper habits of thought in these matters. His introduction to a principle which is new to him should be accompanied by a thorough investigation of all that is implied by it. He should be required to build up for himself a clearly defined picture of the phenomena involved and the whole conception should appeal to his reason and intuitive sense. This understanding is not complete unless he has acquired the ability to express the principle and its associated facts in mathematical terms so that he may perform the required manipulations of the symbols to determine effects which follow logically. The acquisition of fundamental knowledge should go hand in hand with the development of scientific analysis, thus requiring deep-seated understanding and the forming of sound habits of thinking and reasoning.

Because work in physics and mathematics would assume great importance when made to include these essential elements of an engineering education, close coördination in the work of the two departments should commence at the very beginning of the college course and progress consistently through the first two years. Learning a subject and learning its applications should not be two distinct processes. Under our present system of teaching, the application of theories learned in the earlier work is left to later courses in science or engineering. This method requires two separate processes, first learning the principle, and later learning to apply it. The lamentable fact is that the student may never learn to apply much of it, and never fully realizes that it has practical use. He learns important mathematical theorems and intricate manipulations, but finds great difficulty in expressing even the simplest physical facts in mathematical language.

Mathematics is an indispensable part of the engineering curriculum. It should not be taught from a narrow point of view, either as (*a*) purely the science of order and sound logic, or (*b*) only as a tool of practical usefulness. These two points of view should be combined, and at the same time that the beauty, mystery, and logic of pure numbers is unfolded to the student's mind, he should be made to realize that he has at his command a powerful tool for dealing with physical relations. This latter point will become a living reality to him only through close coördination between courses in mathematics and physics. This coördination can be so close that courses in these subjects are planned and taught in such a way that the student might find it difficult to distinguish between them. At one and the same time he would see each subject from different points of view. The mathematician would apply the laws of physics in his mathematical developments, while the physicist is building in the student's mind an understanding of a fundamental law which is being given definite form and expression in mathematical symbols. The principles, manipulations, and techniques of mathematics would then take on new interest. Both subjects would be viewed with a new and broader comprehension as the unity and inter-relationships became evident through a coordinated plan of presentation.

As an example of the type of coördination meant let us consider a very elementary case involving calculus and mechanics. Suppose the student is attempting to grasp the idea of a derivative. The abstract form dx/dy may mean little to him, but give this expression real meaning by consideration of the principle of velocity as the rate of change of distance with respect to time ds/dt, and it immediately takes on a different aspect. The ideas of velocity and acceleration might be developed by discussion in the classroom and actual experiments in the physics laboratory at the same time that the mathematics teacher is considering the derivative. If the instructor in mathematics, knowing about this experimental work in physics, made use of it to illustrate the otherwise abstract idea of mathematics at the same time that the physics instructor was building up a definite physical conception of velocity and acceleration, the student would receive a broader and more fundamental knowledge of both subjects.

The coördination between physics and mathematics courses cannot always be as complete or as simple as in this example but in general the subjects can be correlated in this way through close relationship and coöperation between departments. The instructor in each department would be required to have detailed knowledge of the courses in the other department, so that the work could be carried on simultaneously, each augmenting and supplementing the other.

At first thought, before giving the matter full consideration, it might be contended that mathematics would be debased to the status of a common tool or that the plane of physics would be lowered by such treatment. There is no question that the student receives much value from the study of both of these subjects as courses in pure science. Their very nature creates a broad philosophy and viewpoint. However, none of this is lost through coördination. Everything done in the direction of unification is a gain because it broadens the outlook of the student upon the work of each course and gives him a deeper insight into and a sounder conception of scientific knowledge as a whole. His respect and esteem for the unity and truth in natural law is enhanced by a fuller and more complete understanding of it.

Coördination within an Engineering Department

Much can be done to unify the work within any given department. Electrical engineering will be taken as an example. Developments in technology in this branch of engineering have been most rapid in recent years. The advent of radio introduced a new major field by giving impetus to the application of the vacuum tube so that to-day vacuum tubes find use in every branch of electrical engineering. This requires a knowledge of electronics and related circuits, and associated phenomena, which had no place in our curricula a decade ago. Progress has been so far-reaching that the teaching of electrical engineering must be considered from an entirely new viewpoint to-day. The necessary fundamental knowledge cannot be imparted to the student simply by making a shift in the old courses of the curriculum and adding another course or two to take care of new developments. What is required is a new conception of the field of electrical engineering as a whole, and a new philosophy regarding the acquisition of basic knowledge.

Careful consideration of the whole matter at Worcester Polytechnic Institute has led to the coördination of all teaching within the department. The aim is to have the electrical engineering courses take up the consideration of electrical phenomena at the point where the physics department leaves off, the transition being so planned that there is a simple, logical continuation of the work. The problem here is to make the student realize that he has not completed a course which can be left behind and forgotten, but rather that he is going forward into more advanced work which is a continuation of what has gone before, requiring constant use of the principles he has been learning. In order to carry this out with smoothness and harmony, instructors in each department have to be thoroughly familiar with that portion of the work of the other department which lies close to the transition point.

The work of the electrical engineering department is being carried forward as a single broad course. What were previously considered as separate subjects are brought together into one closely woven whole, which has a steadily expanding scope as understanding develops. Laboratory and classroom courses do not exist separately, but any particular problem receives investigation and study in the laboratory and classroom at the same time. The purpose is to obtain comprehensive knowledge through comprehensive contact and study. This program is built up largely around the general topic of the electric circuit in which phenomena are analyzed in terms of basic principles. Simple cases involving direct current circuits are first considered, followed by the effects of alternating currents of a single frequency. Even in the early stages when the idea of conduction is taken up, cases are considered for metallic conductors, insulators of high resistance, and gases at various degrees of absolute pressure. The ideas of polyphase circuits are developed from the fact that we may have voltages out of phase in a simple single phase circuit. Generated voltages in a network which are not in phase thus present no new principle and if the whole network is analyzed on the basis of Kirchoff's Laws the effects are readily understood. The simultaneous existence of voltages and currents at different frequencies is considered as a special case of the Principle of Superposition. The operation of vacuum tube circuits then becomes a special case involving previously considered principles. The principles of electric machinery are developed one at a time as they fit logically into the picture. This is done to a great extent by consideration of the principle of circuit equivalence. Transmission problems are taken up by consideration of the circuit having distributed constants operating at single- and multi-frequencies. Although the work is thus developed and considered as a whole, for purposes of organization it is catalogued in separate courses and the unification obtained through coördination.

It might be thought that such a plan could not be put into operation without much duplication in laboratory equipment, for the degree of coördination described requires that all students in a class do the same laboratory work each week. Equipment difficulties were alleviated somewhat by the gradual introduction of the plan. Also, careful study showed that much of the laboratory apparatus could be used for many purposes if arrangements were made for such operation. Experience has taught the staff to plan for maximum flexibility of use for all additions of equipment. Another factor in relieving the equipment problem is that by placing the emphasis on basic principles, laboratory work of a specialized nature is eliminated.

It might be mentioned that this form of unification has been adopted for all courses given by the electrical engineering department. The courses for students outside the department, no matter how brief, are single coördinated courses which include both classroom and laboratory work planned on the unification principle.

The Non-Science and Non-Technical Work

The need for unification in that division of the work of the curriculum which lies outside the realm of science becomes increasingly evident as the profession of engineering expands to include social and economic problems. As in science and technology, truly integrated education cannot be obtained from a number of unrelated courses. The subjects studied would still be the same. We would have language, history, economics, and psychology, but they need not exist as independent courses. It may be contended that we cannot expect to accomplish much in the short time that can be made available for these subjects in the present day curriculum. The answer is that the shorter the allotted time the greater is the need for as complete unification as possible.

Our education should be such that our graduates will have the necessary outlook and vision to enable them to apply to social and economic problems the same methods of logic and reasoning that are employed in engineering. With the proper background the student would begin to see that many of the difficulties of the present day are the natural result of what has gone before. He would learn that economic problems are not new to the world and that their solution has far too frequently been sought through methods which were neither scientific nor reasonable. He would also begin to appreciate that many problems cannot be adequately solved without giving due consideration to the action of the human mind.

The coördination of the non-science and the science groups in the curriculum cannot be carried out to the same degree as is possible within the groups themselves. In the early stages there would be a loose relationship which would be valuable in the matter of increasing student interest. Work in the non-science division should include a background of historical knowledge providing an understanding of the development of science and industry. Thus the student would become acquainted with the great scientists of the past, learning the part each played in the development of modern science at the same time that he is gaining knowledge of science itself. He would become familiar with the various changes in society which the world has experienced and the part which technological development has played in the production of

these changes. In the latter years of his course, as he commences to understand something of the way in which the engineer utilizes science to aid mankind, he would also realize that while the effect upon society of a scientific or engineering development of major importance may be far-reaching, the problems arising become much involved; that the financial aspects or the economics of the question are important items; and that the human element introduces phases which assume great magnitude. Coördination should result in bringing all these considerations together in the student's mind with an understanding of the importance of each.

As an example of the way in which the work might be coördinated to give fuller understanding of the many sides of an engineering project let us consider the building of a new machine. In his scientific and engineering studies the student learns about the materials used, how to calculate stresses, and other details of design (so that the required operating characteristics may be obtained). While this technical knowledge is being built up in his mind, he would also learn the importance of costs and all the considerations which must be taken into account in order to determine whether it would be economically sound to undertake the project. He would learn the significance of the human element; that the maintenance of proper relations with the men who actually do the work of construction is just as necessary to the success of the undertaking as the design of the machine. The student should also appreciate that production might cause significant changes in industry, and possibly in society in general. Proper coördination of his various courses should bring out these elements and tie them together so that he would begin to understand the broad considerations which should be given to such a problem. Thus, as he develops in maturity and his formal course draws to an end he begins to appreciate the nature and extent of the work which lies ahead for him, involving not simple questions but problems of extreme complexity requiring in their solution the application of science, economics, and sociology. He would come to see that change has always existed in the world and that as an engineer he should do his part to insure that the inevitable change would be in the right direction.

Idealistic and Practical Aspects

To those who might think that the plan of unification of the curriculum is idealistic rather than practical, the reply is that to a limited extent it is now in operation in many engineering colleges throughout the country. In such institutions it would not be viewed as impractical gradually to extend the degree of coördination in order to obtain increased benefits. The sudden intro-

duction of the complete program at any institution would probably have discouraging results at first. In a plan of this nature the details must be worked out and executed by the individual members of the staff who are directly concerned, and while enthusiastic leadership is necessary it is not sufficient. There must exist a genuine appreciation of the benefits of the plan and enthusiasm for it on the part of the majority of the staff before it can be made to function effectively.

It might seem to one not familiar with it that this plan of unification would have a narrowing effect upon education. If it provided for teaching the separate courses in such a way as to make each meet a particular requirement of the engineering profession and stopped there, it would have such a result. Individual subjects taught from only one point of view, such as "English for Engineers," must necessarily be narrowing. The unification plan is the exact antithesis of this. It contemplates education as a whole, bearing in mind the particular needs of the engineering profession. As such it becomes broad and inclusive as the conception of engineering itself becomes enlarged and comprehensive.

It is generally understood that at best an engineering education cannot hope to make engineers. It provides the beginning of a process which will be carried on continually throughout many years and often during a lifetime. However, the beginning is most important for what follows will depend largely upon the kind of a start that has been made. If we think of the complete education as a structure, the work at college becomes the foundation upon which each individual may continue to build. The beginning of any piece of work always suggests and influences the manner in which it shall be carried to completion. The foundation upon which the young engineer is to build should not appear to him as a number of unrelated pedestals of different shapes and materials. It should be broad and strong, composed of parts which are bound together into one solid whole, thereby inspiring him to build a structure possessing unity, strength, and beauty.

BOOK REVIEWS

Mechanics of Machinery, second edition. C. W. HAM AND E. J. CRANE. McGraw-Hill Book Co., Inc. 476 pages, $4.00.

The authors state that in the preparation of this edition their own classroom experience and the suggestions of others who have used the book for the past ten years have been taken into account.

In the new edition the problems have been moved from the end of each chapter to the end of the book, making them more accessible for laboratory use. The number of problems has been increased from 68 to 141. In nearly all of the problems the scale and arrangement are given for inclusion on an 8½" x 11" sheet.

The major divisions into Part I, "Mechanism," and Part II, "Kinematics and Dynamics of Machinery," have been retained. The chapters under Part II entitled, "Fundamental Concepts" and "Governors," have been omitted, but most of their material has been included under other pertinent chapters. Under Part I a new chapter, "Gear-Tooth Systems and Production Methods," has been included.

The changes and rearrangement of the subject matter and particularly the increased number of problems should increase very materially the value of this text.

G. O. MANIFOLD.

Elements of Steam and Gas Power Engineering, fourth edition. ANDREY A. POTTER AND JAMES P. CALDERWOOD. McGraw-Hill Book Company, Inc. 374 pages, $2.75.

In the new edition the first chapter begins with a discussion of the social aspects of power and the factors leading up to the increased use of power in the United States. A table is included showing the approximate mechanical horsepower available in the United States in 1936 and its distribution; such as, electric central stations, industrial power plants, etc.

The last two chapters, "Locomotives" and "Automobiles, Trucks, Tractors, and Airplanes," of the third edition have been consolidated into one chapter, "Mechanical Power in Transportation."

The number of problems has been increased in most chapters, and the subject matter has been revised.

G. O. MANIFOLD.

A Hundred Years of Mechanical Engineering. EDWARD CRESSY. The Macmillan Co., N. Y. (Printed by the Kemp Hall Press, Ltd.) Price $4.25.

This book should provide the graduate mechanical engineer with the proper historical background. Most modern technical education neglects the significance of historical impression—a void which this book will fill. It should provide the need for a textbook in the so-called "technical history" courses now being offered to seniors of some technical schools. However, for such courses, there is insufficient, authentic reference to establish historical dates.

All phases of the historical development of mechanical engineering are explained with clearness and a surprising amount of detail is actually covered within the 324 pages. This is usually true of most British authors who have the ability to carefully weigh and select the proper words and phrases which result in pleasant reading and a clear understanding. However, the author does give due credit to American ingenuousness. The use of British Terminology should not confuse the reader (such as, tyre for tire, skew-bevels for hypoid, jockey pulley for idler, petrol for gasolene, et cetera).

The book is divided into three parts, The production and distribution of power, Materials and processes and Applications of power. There are many figures and plates which further clarify the author's explanations.

All engineers, especially technical authors, would profit by reading this book or at least that section dealing with the subject concerned—for which there is provided a very handy index.

STEPHEN J. TRACY, JR.

Fundamentals of Electrical Engineering (First Edition). M. B. REED. International Textbook Company. 326 pages.

This should be a real contribution to electrical engineering literature. The basic fundamentals of electrical engineering are treated mathematically. In fact, the differential concept occurs quite frequently in the latter part of this book. It seems that a definite effort has been made to develop mathematical concepts. While the book is intended for an introductory course in electrical engineering, it presupposes some knowledge of calculus, or calculus as a co-requisite.

Professor Reed has used the well known double subscript method of a.c. circuits in his treatment of d.c. circuits and Faraday's Law for self- and mutual-induction voltages. Accordingly the use of it here should be a time saver for the student because when he has

finished this course and is ready for the study of a.c. circuits he finds himself equipped with the much needed double subscript system.

The book contains thirteen chapters including, Energy Relations in Electric and Magnetic Fields and circuits, transients, and conduction through gases and across gas-solid boundaries with applications to electron tubes. There are thought-provoking problems at the close of each chapter. A total of 276 problems are included in the book. Since in most cases a straight substitution in formulas will not solve these problems some guidance on the part of the instructor will be necessary for the student to be able to think them through successfully.

R. C. GORHAM.

Advanced Calculus. BENJAMIN FITE. The Macmillan Co., New York, 1938. xi, 399 pp. $5.00.

American mathematicians have witnessed the appearance of four native texts on "Advanced Calculus." One may, perhaps, state that a tradition has now been established comparable, though on a much smaller scale, to the French tradition with respect to general treatises on analysis.

The structural lines on which the first three of these books have been built are somewhat alike. They include, besides those topics which, of necessity, form the content of any text on advanced calculus, a number of special topics which, for the most part, have been treated in more or less comprehensive works devoted to them primarily; topics which form, indeed, the subject matter of separate courses in our colleges and universities. I refer, particularly, to Vector Analysis, Differential Equations and Elliptic Functions. Each of these books assumes, therefore, somewhat the aspect of a "book of books" on the biblical plan. There is to be sure a strong chain of connection inevitably present in the unifying central concept of function. Moreover, one should not feel ungrateful when a competent author chooses to incorporate in his text valuable special chapters which undoubtedly can contribute much to the students' store of knowledge.

Professor Fite's book marks, however, a clearly different departure. It sins least, if at all, by inclusion of excrescences. Its mathematical garden has been carefully weeded. (Someone has defined a weed as any plant, however beautiful, that is growing out of its proper place.) As a result the beauty of the floral offering is considerably enhanced. Within narrower limits the author has achieved a definitely finer artistic effect. Which, if any, of the chapters in Fite's book would I omit if I wished to gain for it that

esthetic unity which I shall assume (wrongly) that it does not possess? I can think of none.

The author himself uses the term "special" in describing his chapter on the calculus of variations and suggests that because of his quality that chapter had better be omitted rather than the one on functions of a complex variable in case both cannot be taken up in the course. However, the first of these chapters is such a natural transition from the notion of extreme value of a function, and the latter seems so desirable for carrying out the first stage of the extension of analysis to the complex domain as foreshadowed in the opening chapter on the number system, that I would somehow contrive not to omit either.

In all there are fifteen chapters, the first of which, as has been mentioned, is a brief discussion of the number system, the foundation of analysis. "Many teachers," writes the author in the preface, "will prefer to assume the real number system which is discussed in Chapter I; and to pass directly to Chapter II." That may be true, but, in the reviewer's opinion, it would be a pity to omit this brief but splendid overture. It is, however, a matter for regret that, in a chapter devoted in great part to an exposition of the Dedekind cut, no mention of the illustrious inventor has been made; and this despite the fact that the author has gone to the trouble of inserting a small footnote to inform the student that the symbol commonly used to denote the imaginary unit is due to Euler. The student may find himself, with respect to this fundamental tool of reasoning, the Dedekind cut, in a position not unlike that of Moliere's bourgeois gentilhomme who discovered, to his surprise, that he had been speaking prose all his life without knowing it.

Following Chapter I are successive chapters on functions of a single variable, functions of several variables, Taylor's expansion with the remainder, definite integrals, indefinite integrals, improper and infinite integrals, double and triple integrals, infinite series, power series, trigonometric series and orthogonal functions, implicit functions and functional determinants, applications to the geometry of curves and surfaces, calculus of variations, and functions of a complex variable. The accompanying problems are significant and sufficiently numerous.

The reviewer regrets, despite of the author's self-avowed precaution, that he has not seen fit to include a more generous list of references, since such a set, not *too* elaborate as to be confusing, would, I believe, be of great service to the student in directing his further investigations. However, this is a minor point.

The author has, it seems to me, judiciously and unerringly selected those topics of a general nature which are likely to prove

indispensable in all the student's later and more specialized work in analysis. He has succeeded in producing a body of minimum essentials, a sure foundation on which the student can confidently base his operations as he continues his forward march of exploration. Moreover, he has presented his material so skilfully, not only from the standpoint of clear and rigorous exposition of separate topics but also from that of topical sequence, that the resulting ensemble evokes our sincerest admiration. Fite's Advanced Calculus is destined to take its place at once as a classic among American textbooks, by the site of such works as Bôcher's Higher Algebra and Snider and Sisam's Analytic Geometry of Space—to mention only two.

A. E. STANILAND.

Thermodynamics Fluid Flow and Heat Transmission. HUBER O. CROFT, *University of Iowa.* McGraw Hill Book Co., New York, 1938. 312 pages.

This book covers three branches of engineering which are closely related but ordinarily not given in a single course. It is intended for use in a senior or graduate course correlating the three branches. An elementary knowledge of thermodynamics and of hydraulics is presupposed although these are briefly reviewed.

The arrangement of the book is extremely good as it leads the student from the fundamental definitions and fundamental mathematics needed into the more complex subjects such as the characteristics of solid particles in fluid streams. Many charts, graphs, and tables are included in the text and others are included in an appendix. The abundance of these makes the book valuable as a reference book.

The author should also be complimented for his consistent use of dimensional analysis and the accompanying correctness of the units used. In these the book shows a great deal of effort on the part of the author.

F. L. BISHOP, JR.

The Preparation of Reports. RAY PALMER BAKER AND ALMONTE CHARLES HOWELL. The Ronald Press Company, N. Y. 1938.

Written reports are made in every phase of work of a scientific, engineering, financial or administrative character. Thus the contents of this book should be of major interest to all industrial executives, engineers, and to students in engineering and industrial administration.

This text is a complete re-writing of Professor Baker's book bearing the same title, published in 1923. However, his collabora-

tion with Professor Howell, author of the "Handbook of English in Engineering Usage" (John Wiley & Sons, 1930) has brought to the book much new and interesting material. The timely comment and subject matter make it an indispensable volume for the engineer and executive and a valuable text for courses in report writing especially in engineering schools and colleges.

As Professor Baker's earlier book is such a well-known and established guide in report writing, this review will be limited to the new material in this edition. In general, the illustrative material and exercises have been brought up to date. Such illustrative reports as that of the Audit Bureau of Circulation of Colliers, pp. 82–84, the Recommendation Report on the Potomac River Drainage Area, pp. 285–288, by the U. S. Army Engineering Office, the operation reports on time and motion studies and other reports on industrial management bring to the book a current point of view.

In particular, the authors have added a splendid presentation of the use of statistics in reports in Chapter seven. The careful study of this topic will enable the student and the younger engineer to present more ably their data in statistical studies and methods. The authors have augmented the presentation of experimental research reports. The reading of chapters nineteen and twenty by the engineering student, prior to writing his thesis, will be of immense value to him. The treatment of theoretical and descriptive reports and their directions concerning the preparation of manuscripts and proof are most explicit.

The fundamental philosophy of the book is the timelessness and timeliness of this matter of report writing. Starting with the Anabasis 400 B.C. and coming on to discuss Frantinus' report on the water supply of Rome, 100 A.D., down to some of the more recent reports on huge governmental projects in 1938, the material shows this first quality of timelessness. The matter of timeliness is discussed in a letter to the authors from Major John Coffee Hays, Vice-President of Stone and Webster Engineering Corporation, in which he says: "The engineering concern . . . must be continually on the alert to see that the things they say really express what they mean. One simple working rule is a sound reading of any letter or report from the viewpoint of how the writer thinks it might look one year from now and under completely changed business conditions."

There is an appendix giving recent comments on report writing, a special index of reports, books and articles, and a good general index.

WILLIAM H. H. COWLES.

Elements of Mechanism. MERRILL AND JAMES SCHWAMB. Fifth edition. John Wiley and Sons.

The work under review is an excellent example of a book so basically sound that fifty years after its original appearance it is as useful as ever, no radical changes being necessary. The later editions simply represent an orderly evolution to meet later day requirements.

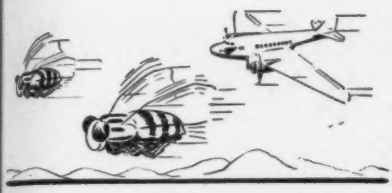
In the present edition the growing importance of a knowledge of accelerations in mechanisms is recognized, and the treatment of this important subject has been considerably expanded and improved. The study of velocity analysis is also strengthened, and increased use is made of vector methods, though the velocity polygon is developed as fully as it might be.

The order and arrangement has been altered to some extent as experience has shown such changes to be desirable. Some topics of secondary importance have been cut down or omitted.

The new edition should be heartily welcomed and should enjoy as wide a popularity as its predecessors.

J. A. DENT.

G-E *Campus News*



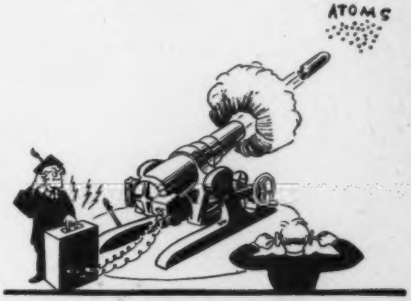
SPEEDY FLIES

THERE are many legends of nature which have remained for many years, eventually being refuted by naturalists, but one which has persisted up until a few weeks ago is that of the phenomenal speed of the deer botfly. While man plods along at a speed of 400 mph in his airplane, one entomologist calculated the speed of the deer botfly to be 800 mph. Digressing from his usual types of experiments, Dr. Irving Langmuir, Nobel Prize winner in the General Electric Research Laboratory, exploded this entomological myth by means of a series of tests.

Using a piece of solder the size and shape of a deer botfly, Dr. Langmuir proved that if this insect traveled at 800 mph it would encounter a wind pressure of 8 pounds per square inch—enough to crush it, and that maintaining such a velocity would require a power consumption of ½ hp—a good deal for a fly. He also demonstrated, using the solder model, that the insect, while flying at only 60 mph, is invisible, yet the entomologist estimated the speed of the fly at 400 yards per second because he saw a brown blur pass by his eyes. Finally, the calculation proved that if the fly struck a human being it would penetrate the skin with a force of four tons per square inch.

BOMBARDING ATOMS

THE modern miracles of aviation, television, and World's Fairs are taken quite calmly in this twentieth century of progress. But it is a different matter when scientists start snapping the whip with ions to smash ultramicroscopic particles called atoms into even more minute portions. And that's just what scientists are doing over at Harvard University.



Using a machine called a cyclotron, devised by Prof. Lawrence of the University of California, the Harvard physicists are bombarding atoms by accelerating ions to a tremendous speed and shooting them out through a hole in the side of the machine. But people are talking about this barrage of ionic ammunition because the results have proven successful in the treatment of cancer.

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To be published in September. $4.50 (probable)

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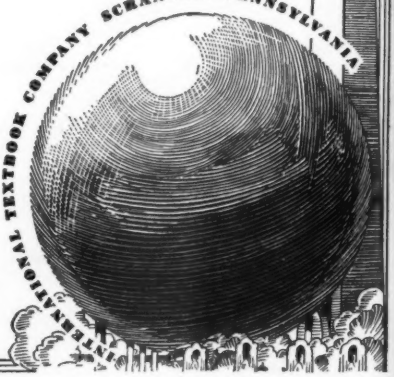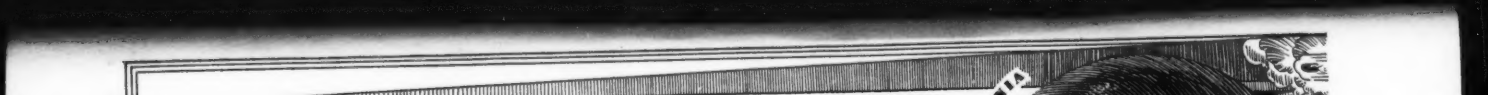
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